

COGNITIVE PROCESSING OF BLISSYMBOLS

BY NORMAL ADULTS

by

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ABSTRACT

Proposed by their inventor as an international visual-symbolic language, Blissymbols gained acceptance as a communication system for nonvocal handicapped populations. However, basic research has not kept pace with the rapid increase in application. The purpose of this thesis was to study the cognitive processing of Blissymbols to determine (a) the degree to which they represent their word referents, (b) the effect of this representativeness on learning and memory, and (c) the extent to which Blissymbols are processed like pictures and thereby concretize abstract concepts. The studies, conducted within the framework of Paivio's (1971) dual coding theory, began with collecting and validating normative data on the psychological attribute of representativeness. Next, studies were designed to examine the effects of representativeness on incidental learning and transparency of Blissymbols. Finally, two experiments made use of encoding procedures to examine the effects on learning and memory of Blissymbols varying both in representativeness and in concreteness of the concepts they represented.

The early studies established a corpus of 464 Blissymbols with ratings of representativeness and imagery. In addition, these studies demonstrated a positive correlation between representativeness and word attributes such as concreteness, imagery, printed familiarity, meaningfulness and Thorndike-Lorge frequency. Also, representativeness was shown to have a positive effect on naive subjects' learning of associations between symbols and concepts.

Results of memory studies using Blissymbols were consistent with those reported previously for comparable picture-word studies. That is, words to which knowledgeable subjects generated Blissymbols and words that were generated to Blissymbols were recalled better than words coded by synonym or copy tasks. Also, concrete and abstract words associated with Blissymbols in the encoding task were recalled with equal frequency whereas concrete words were recalled more frequently than abstract words in the synonym and copy tasks. These findings suggests that Blissymbols concretize abstract concepts and thus enhance their memorability.



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The results suggest that Blissymbols are processed in a manner similar to picture processing and are capable of concretizing abstract concepts. Also, symbol representativeness appears to be an important attribute that needs to be considered in any experimental or clinical application of Blissymbols.

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INTRODUCTION

The purpose of the research presented in this thesis was to study the cognitive processing of Blissymbols (Bliss, 1965), a recently invented logographic symbol system inspired by Chinese writing. Blissymbols represent concepts by pictographs that look like their referents, and by ideographs that symbolize more abstract ideas, neither of which give clues to the pronunciation of the referent's name. The research sought to provide information on basic psychological attributes of the symbols.

There are at least two reasons why research on Blissymbols is important. First, Blissymbols were intended to serve as the basis for an international written communication system using symbols that unambiguously represented words and their meanings. However, since the introduction of Blissymbols as a communicative system, their use has spread without the relationship between symbol and word having been tested empirically. A second and more theoretically interesting reason for studying Blissymbols is that they are uniquely nonverbal in structure and represent abstract as well as concrete concepts singularly. In contrast, natural language logographs use syllabic scripts to represent many of their

abstract concepts and, because of their close relation to spoken language, even the pictographic symbols have incorporated phonetic cues to their pronunciation. Thus, Blissymbols present researchers with a unique opportunity to investigate the cognitive consequences of a "pure" nonphonetic logographic symbol system.

The thesis consists of a program of research which began with several studies to determine the relevant psychological attributes of Blissymbols and test the validity and reliability of these attributes. Following the pilot studies, norming studies were carried out to build a large pool of symbols that represented both abstract and concrete words to be used later in experimental studies. The studies were conducted within the framework of dual coding theory (Paivio, 1971). The remainder of this introduction will detail some of the historical and theoretical issues relevant to the study of Blissymbols, and outline the relevant assumptions of dual coding theory.

Historical and Theoretical Relevance

In his book, *Semantography-Blissymbolics* (1965), C.K. Bliss proposed an international visual-symbolic language that was modelled after the Chinese system of writing. Blissymbols (see Figure 1) consist of pictographs, arbitrary abstract symbols that existed before Bliss (i.e.,

Pictographs



CHAIR



UMBRELLA



LETTER

Ideographs



UP



INTO



MIND

Arbitrary



THAT



HAVE



DESTROYED

Conventional



DOLLAR



PERIOD



MULTIPLICATION

Combined



BUILDING



BOOK



LIBRARY

Superimposed



LIFE



DESTROYED



DEATH

Figure 1: Types of Blissymbols

conventional signs or mathematical symbols), and arbitrary abstract symbols (or ideographs) devised by Bliss (Archer, 1977). A Blissymbol can singularly represent an idea or concept, although the symbols can also be combined productively to represent events much as in traditional orthography. This capacity to represent time and space using only conceptually based logographs, whose structure gives no clue to their pronunciation, is in contrast to natural logographic writing systems (i.e., Chinese, Japanese, and Korean). The natural systems use logographs, of which many are phonograms, in combination with syllabaries or alphabets to attain the same goal of communication that Blissymbols achieve without the addition of such linguistic components.

The symbols never gained acceptance as an international written language. However, they were adopted in 1971 by the Ontario Crippled Children's Centre in Toronto to be used with Cerebral Palsied patients with normal intelligence. From this early beginning, the clinical application of Blissymbols has been extended to such handicapped populations as the deaf, mentally retarded, multiply handicapped, autistic, and blind (Bliss Communication Foundation Bulletin, 1977). The symbols are now being used in over three thousand centres throughout North America and Europe (Archer, 1977). Unfortunately, basic research on the symbols has not kept pace with the rapid increase in clinical application. In addition,

clinical studies have neglected some basic issues involved in the processing of written material. The next section details one of the relevant questions associated with these basic issues.

Stimulus Attributes

One of the most important questions that has been neglected in the applied studies is the identification of stimulus attributes that are relevant to processing of Blissymbols. Stimulus attributes are considered only in a general way during the selection of a system to be used in therapy, without reference to findings that indicate the importance of relevant psychological attributes of stimuli in cognitive tasks. For example, it has been demonstrated that the concreteness of a stimulus correlates positively with performance on a variety of tasks that are relevant to memory studies (for reviews, see Gorman, 1961; Jampolsky, 1950; Olver, 1965; Borkowski & Eisener, 1968; Madigan & Lawrence, 1980; Paivio & Yarmey, 1966), as well as tasks that emphasize associative speed (e.g., Paivio, 1966; Smith & Harleston, 1966; Yuille & Paivio, 1967) and communicability of words (e.g., Begg, Upfold & Wilton, 1978). Despite such findings, the methods used in teaching Blissymbols generally take no account of concreteness or other variables that might affect the cognitive processes involved in the storage, retrieval and utilization of

"written" material. For example, a review of the pertinent literature reveals that recent research with Blissymbols has been concerned with applied problems such as practical considerations for implementation (Harris-Vanderheiden et al., 1975; Song, 1979; Galloway, 1978); comparative learning between different systems (Clark, 1981; Hurlbut, Iwata, & Green, 1982); and effectiveness as a communicative system (Ross, 1979). The only nonclinical study found was a recent investigation on the guessability of Blissymbols as compared to two other pictographic systems (Musselwhite & Ruscello, 1984). In this last study, as in the others cited, there was no mention of psychological attributes of the stimuli.

This neglect of stimulus attributes is not unique to the study of Blissymbols. To support the use of Blissymbols and the procedures carried out in this thesis, the criticisms leveled at the research with natural language logographs is used to illustrate the pitfalls that should be avoided and issues that should be addressed by a systematic program. The next section will briefly discuss the research with the natural language logographs as it pertains to the study of Blissymbols.

Research with the Natural Language Logographic Systems

Recent criticisms of the research with natural language logographic writing systems (Hung & Tzeng, 1981) dealt

mainly with the lack of careful control of stimulus attributes. For example, Huang and Jones (1980) were criticized for failure to specify the "nature" of the 12 single characters they arbitrarily selected for their study, while Nguy, Allard and Bryden (1980), were criticized for misclassifying the Chinese characters they used in their research.

Another variable, the phonographic nature of the symbol characters, has been neglected in the literature. Gibson and Levin (1975) point out that though the phonographic characters do not represent the component sounds of their spoken name, they do give clues to the pronounceability of the character. Figure 2 gives two examples of chinese phonograms and how they operate in changing the pronunciation and meaning of the base characters. These clues may confound results in logographic studies in which picture-word type comparisons are made. These clues are absent in Blissymbols.

Psychologists interested in Chinese, Japanese and Korean scripts have raised the issue of whether the symbols are processed like pictures, written words, or both. For example, Gibson and Levin (1975) suggested that Chinese characters are similar to pictures and different from traditional orthogography (written words) in three respects: (1) they are graphically unified; (2) they may represent features of their reference directly (e.g., the trunk and branches of a tree make up the character for

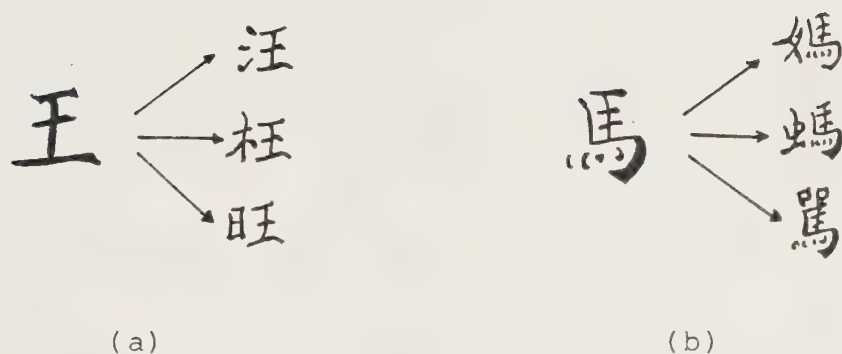


Figure 2. Examples and Explanation of Chinese Phonograms

- (a) The character on the left side is the base character and is pronounced as /wang/. The three characters on the right are derivatives that contain the base character as a clue to their pronunciations. In fact, they are pronounced as /wāng/, /wǎng/, and /wàng/ from top to bottom, meaning "The barking sound of dogs".
- (b) The base character on the left is pronounced as /ma/. It means "horse", and it is a pictogram by itself (see Wang, 1973). Similarly, the three derivative characters on the right are pronounced as /mā/, /mǎ/, and /mà/, meaning "mother", "ant", and "to scold", respectively. Thus, if a reader knows how to pronounce the base characters, he or she can guess at the pronunciations of the derived phonograms that contain the base character as a partial component (Hung and Tzeng, 1981, p. 380).

tree) and; (3) they do not represent the component sounds of their spoken names.

Sasanuma and Fujimura (1971, 1972) compared two clinical groups' ability to read Kanji and Kana scripts with that of a normal control group. Figure 3 shows some Kanji symbols that were originally pictographic but have evolved through the years into highly stylized ideographs. The Kana script is a syllabary and, according to Sasanuma and Fujimura, is therefore well suited to phonological mediation, whereas Kanji is not. McCusker, Hillinger, and Bias (1981), in a review of Sasanuma and Fujimura's (1971) results concluded that, "The syllabic Kana characters are read via a phonological representation, whereas the ideographic Kanji characters are not" (p 238). Shimamura (1982) on the other hand, concluded that Kanji facilitates both logographic and verbal processing whereas the Kana facilitates mainly verbal processes. Final justification for comparing symbols in the picture-word context comes from a study that used Korean subjects and the two scripts of Korean (Park & Arbuckle, 1977). The study also implicated dual coding theory directly in the study of logographs. Park and Arbuckle used recognition memory, free recall, paired-associate recall, and serial anticipation tasks to determine whether type of script affected its memorability. They selected concrete and abstract English nouns from the Paivio et al. (1968) norms and translated them into the Korean logographic and

	(FOREST)	(MOUNTAIN)	(FIRE)	(FISH)
KANJI	森	山	火	魚
HIRAKANA	もり	やま	ひ	うお
KATAKANA	モリ	ヤマ	ヒ	ウオ

Figure 3: Examples of the stimuli (kanji) as compared with the other two types of Japanese lettering (Hatta, 1977, p. 686).

alphabetic scripts (see Figure 4 for examples of each script). The relevant results for present purposes were that words presented in ideographic script were remembered better than the same words presented in alphabetic script in recognition and free recall tasks.

This last finding parallels differences found between picture and word recall, and is similarly consistent with the idea that different processes are involved in reading verbal and nonverbal materials. That is, the process involved in the recall of meaningful printed material depends, in part, on whether it is represented as orthographic or nonorthographic configurations (Besener & Coltheart, 1979; Brooks, 1977; and Hung & Tzeng, 1981). The view that words and pictures are processed differently has received support from Paivio, (1971) and his colleagues. Picture superiority over words (Paivio, Rogers & Smythe, 1968) has been demonstrated in studies of paired associate learning (Paivio & Yarmey, 1966; Postman, 1978), recognition memory (Madigan, 1983), and free recall (Madigan & Lawrence, 1980). This superiority in recall of pictures over words, within the framework of dual coding theory, is supportive of the position that the two classes of stimuli are processed differently.

The research with natural language logographs has demonstrated that some logographic symbols are processed in a manner similar to pictures. Blissymbol logographs range, in their construction, from being concrete pictographs to

IDEOGRAPHIC	ALPHABETIC	MEANING
安	안	peace
好	호	good, to love
妹	매	younger sister

Figure 4: Three examples of one character Korean logographs and their alphabet equivalents

The semantic features of the logographs can be illustrated by analyzing them into their component parts. The common element for all three characters is the radical for woman. In the first example, the second element, which signifies roof, is placed above woman to denote peace; thus peace is one woman under one roof. In the second example, the element to the right of woman means child, with the compound denoting good or to love. These first two examples illustrate one type of character, the logical aggregate, in which both elements of the character contribute to its meaning (Wieger, 1927/1965). The third example illustrates a second type, the phonetic complex, in which one element contributes the meaning and the second suggests the sound. The term "suggests" is used advisedly; an ideogram is a word, but the relation between any phonetic information given in the ideogram and how that word is pronounced is complex, in part because the spoken language has altered much more than the written language over the centuries (Park and Arbuckle, 1977).

abstract ideographs. Park and Arbuckle (1977) make the point that, "in picture-word studies the verbal labels for pictures are necessarily concrete" (p.633). It seems therefore, if Blissymbol pictographs were processed in a functionally similar manner as pictures, then this processing would occur regardless of whether the symbols represented concrete or abstract concepts. The uniqueness of Blissymbols is that they represent both abstract and concrete concepts holistically. The symbols of special interest, therefore, are the ideographs that represent abstract concepts. The question is whether those symbols concretize the abstract concepts they represent in the sense that they function more like pictures than words in tasks that are sensitive to such functional differences. The question implicates dual coding theory, which is reviewed in the next section.

Dual Coding Theory

Dual coding theory is relevant to the study of Blissymbols because the theory emphasizes separate cognitive representations for verbal and nonverbal stimuli. The assumptions of the model will be reviewed specifically as they relate to the issues of the thesis.

Paivio (1971, 1978, 1981) based dual coding theory on the assumption that memory and cognition are served by two separate symbolic systems, one specialized for dealing with

verbal material and the other with nonverbal information. The two systems are presumed to be interconnected but capable of functioning independently. Interconnectedness means that representations in one system can activate those in the other, so that, for example, pictures can be named and images can occur to words. Independence implies, among other things, that nonverbal (imaginal) and verbal memory codes, aroused directly by pictures and words or indirectly by imagery and verbal encoding tasks or other contextual cues, should have additive effects on recall. However, additivity is not restricted to verbal and nonverbal codes. Paivio and Desrochers (1980), in an extension of dual coding theory to bilingual memory, incorporated the assumption that there would be additivity in recall between two languages. The results supported their prediction. However, recall for translation was less than that found for recall of materials coded verbally-nonverbally (Paivio & Lambert, 1981). They explained their results as being due to the picture naming condition profiting from the mnemonic superiority of the image code whereas bilingual coding presumably engaged two verbal codes of equal mnemonic value. The relevance of dual coding theory, and its bilingual extension is that they offer predictions and procedures to investigate the main question of the thesis.

To summarize, Blissymbols were selected to be studied for several reasons. First, the relationship between symbol and its meaning had never been tested empirically.

Second, Blissymbols were intended to be "pure" logographs which can be studied without confounding from phonographic cues that are incorporated into natural language logographs. Third, research with natural language logographs has revealed a need to control psychological attributes of the stimulus materials carefully, and has suggested that logographic symbols be studied within a picture-word framework. Blissymbols, because of their relatively "pure" pictorial form, appear to be a more appropriate type of stimulus for picture-word processing comparisons than are their natural language counterparts. Dual coding theory (Paivio, 1971) is particularly relevant to studies comparing the processing of pictures and words because its assumptions concerning the processing of verbal and nonverbal materials allow for testable predictions.

The next section briefly outlines the studies that began the program of research. Only the pertinent findings will be presented because the studies are reported in detail elsewhere.

BLISSYMBOL ATTRIBUTES: IDENTIFICATION AND MEASUREMENT

The purpose of the exploratory studies was to identify relevant psychological attributes that affect processing of Blissymbols by normal adults, and to develop measures of those attributes so that they can be compared with measures already available for the word referents of the symbols. In addition, studies were carried out to establish the validity and reliability of these attributes. The following three attributes were examined in these studies; representativeness, concreteness and, imagery.

First, representativeness (R), was defined as the degree to which a symbol represents its word referent. This attribute was of primary importance because Bliss (1965) claimed that there is, "A simple semantics contained in the symbols, exposing vague and ambiguous meaning" (p-52). The relationship between symbols and their referent meaning has not been tested empirically and therefore it was important to determine how well the symbols represent the referent concept. Second, concreteness was measured because the symbols are intended to represent both concrete and abstract concepts. Finally, imagery value was measured because of demonstrated predictive and explanatory power of imagery in prior

research comparing pictures and words in various tasks, and because imagery is conceptually related to the concreteness/abstractness (or iconic vs noniconic) representative nature of Blissymbols.

The general approach of the research program was consistent with the guiding theoretical model and attempted to avoid the criticisms directed at the research carried out with other logographic systems. For example, this section begins by describing five studies designed to identify and measure the relevant psychological attributes. The description of the studies is limited to the essential points, as detailed accounts of the studies can be found in Yovetich and Paivio (1981).

Representativeness Ratings by Naive Subjects

The initial study (Yovetich & Paivio, 1980) was designed to provide representativeness ratings for Blissymbols that were originally intended to represent abstract and concrete words. Forty subjects, selected from the university community, were asked to rate 303 Blissymbols on the degree to which each symbol represented the written concept. The rating required subjects to make a judgment on the degree of relationship between a symbol and a corresponding word (see Appendix B). The ratings were done on a seven point scale (cf. Paivio, Yuille & Madigan, 1968). The resultant ratings ranged from 1.18 to

6.98 indicating that subjects utilized the full extent of the scale in their ratings ($\bar{x} = 3.4$). However, the distribution of scores was slightly grouped at the low end of the scale (47.5 % of the symbols were rated as less than 3.0 whereas 12.3 % were rated as 5.0 or above). Intra-subject reliability was calculated using the representativeness ratings of 18 pairs of synonyms, each member of a pair being depicted by the same symbol (e.g., big-large). The results revealed a high positive correlation ($r = .89$) between the synonym representativeness ratings, indicating satisfactory reliability. Pearson product-moment correlations between the symbols' R values and the values available (Paivio et al., 1968) for concreteness, imagery, meaningfulness, printed familiarity, and Thorndike-Lorge frequency of the corresponding concept revealed low positive correlations between representativeness of the symbol and the other variables ($r = .27$ for imagery; $r = .16$ for concreteness; $r = .15$ for printed familiarity; $r = .19$ for meaningfulness; and $r = .10$ for Thorndike-Lorge frequency, $df = 301$). Independent t -test analysis across subjects for male and female representativeness ratings revealed no significant difference between the sexes, $t(38) = 1.18$, $p > .05$.

The low positive correlation found between R and the other variables indicates that it is not related, to any great extent, to these variables. The low correlation between R and concreteness is somewhat surprising, however,

since it would be expected that concrete items would be represented by pictographic symbols and would receive high representativeness ratings due to their iconicity. The abstract items, on the other hand, would be represented by ideographs. Because the subjects were naive with respect to the meaning of the symbols their private and partly idiosyncratic representations may have conflicted with the Blissymbol representations. Thus their lack of knowledge may have depressed the correlation between R and item concreteness. The effect of knowledge of the system on representativeness ratings was investigated in the next study.

Representativeness Ratings by Knowledgeable Subjects

The second study (Yovetich & Paivio, 1980), investigated the degree to which knowledge of the language members and morphological rules of Blissymbols affected their representativeness ratings. Forty subjects were selected if they had the minimum of one course from the Bliss Communication Institute (BCI) on the use of Blissymbols. It was expected that these subjects could apply their knowledge of the system to the rating task and, therefore, that their R ratings would be higher than the ratings obtained from naive subjects. The argument is offered that these subjects would engage in additional processing by searching for simple symbols within complex

ones and applying the morphological rules of Blissymbolics to analyze for meaning before rating them. This activity therefore is a process of reconfirmation of a previously learned symbol-concept association. In contrast, it was argued that naive subjects would rate the symbols according to the degree to which the symbol coincides with their private and partly idiosyncratic conception of the nonverbal or symbolic representation for that concept.

The resultant ratings supported the expectation in that knowledgeable subjects rated the Blissymbols significantly higher than naive subjects, their mean being 4.23 as compared to a mean of 3.4 for naive subjects, $t(78)=14.0$, $p < .001$. Comments by many of the "knowledgeable" subjects confirmed that they were applying morphological rules to process the symbols. That is, they were reading the symbols for meaning before rating them on the representativeness attribute. Based upon the higher mean rating and the subjects' comments, it appeared that representativeness was a psychological attribute that was affected by the subjects' knowledge of the symbols and the morphological rules of the system.

Incidental Recall

The next two studies were designed to test the validity of representativeness as a relevant psychological attribute of Blissymbols. The first study (Yovetich & Paivio, 1980),

using an incidental recall task, explored the effects of Blissymbol attributes on relatively short-term recall (STM, N=28) and relatively long-term recall (LTM, N=14). The rationale was that incidental recall would provide evidence on the validity of the R attribute early in the research program. The volunteer subjects were selected from the university community with the only restriction that they were not familiar with the symbols or the experiment. Both STM and LTM groups were required to carry out the orienting task in which they rated the R values of the symbols. Immediately upon completion of the rating task, the participants in the STM condition were handed a new sheet with the symbols rearranged and unaccompanied by the written words. They were asked to write the words that had been previously paired with each symbol. The members of the LTM group returned within a three-week period at which time they were asked to recall the nouns that had been paired with the symbol cues. The results of the study revealed the following information. Subjects in the STM task correctly recalled 28% of the nominally correct word labels for the stimulus symbols. An additional 7.2% of their responses were synonyms of the words originally paired with the symbols. If one views the synonym responses as correct, the total correct response percentage increases to 35%. In contrast, subjects in the LTM group were only able to recall 4.4% of the words and an additional 2.3% of their responses were synonyms of the

Table 1

Correlations of representativeness and concreteness with mean recall of
the 303 items across subjects on the incidental learning task

	Representa- tiveness	Significance Level	Concreteness	Significance Level
<u>STM (df = 301)</u>				
Nominal Recall	0.689	.001	0.301	.01
Synonym Recall	0.729	.001	0.329	.01
<u>LTM (df = 301)</u>				
Nominal Recall	0.575	.001	0.204	.01
Synonym Recall	0.622	.001	0.209	.01

correct word, for an overall correct recall percentage of 6.7%. In addition, Table 1 shows that mean recall scores for the 303 symbols correlated moderately and significantly with representativeness values and mildly but still significantly with concreteness of the word concepts. These results suggest that the most effective characteristic of the symbols that enhance their learnability is the degree to which a symbol is perceived as being highly representative of the concept.

Examination of the items recalled in both STM and LTM conditions revealed that 27.7% of the items in the STM condition and 63% in the LTM condition were rated high on both symbol representativeness and word concreteness. These results suggest that the most effective characteristic for both STM and LTM is the degree to which a symbol is perceived as being highly representative of a concrete concept. An alternative explanation for the results might be that the pictographic or iconic symbols simply made the task a reconfirmation of the association between symbol and word rather than recall of a newly learned one.

Transparency of Blissymbols

The second validation study (Yovetich & Young, 1983), examined the influence that representativeness of symbols and concreteness level of their word labels^{had} upon the transparency (or "guessability") of 64 Blissymbols.

Subjects were asked to give the word label they thought the symbol represented. Transparency was determined by scoring written responses to symbols presented without labels, as exact, synonymous/(related) or other. The prediction was made that subjects would be more accurate in labelling symbols independently rated high on concreteness and representativeness than symbols rated low on these attributes. In this situation, accuracy refers to the correspondance between the written response and meaning as defined by the Dictionary for Use (Hehner, 1981).

In view of the criticism directed at research with natural language logographs, the importance of this type of information was strengthened by a recent article by Musselwhite & Ruscello (1984). In their study, the authors compared the transparency or "guessability" of Blissymbols with that of two other symbol systems. However, like the natural language logograph research, reviewed earlier (p.6), Musselwhite and Ruscello did not acknowledge the issue of, nor control for the psychological attributes of stimuli and their potential affect on learning and memory.

Method

Subjects. Twenty volunteer university undergraduate students (10 males) served as subjects. They ranged from 21 to 23 years of age ($\bar{x}$ = 21.9).

Materials. Seventy-six Blissymbols were arranged in random order on five pages by an individual who was unaware of their categorization and meaning. There were six rows of

three symbols each on four pages and four symbols on the final page (see Appendix D). The symbols were selected from the Yovetich and Paivio (1980) data so that there were sixteen from each of four categories, high representativeness -high concrete (HRHC), high representativeness -low concrete (HRLC), low representativeness -high concrete (LRHC), and low representativeness -low concrete (LRLC). Twelve additional items, varying in the concreteness value of their written concepts, and unrated in terms of symbol representativeness were included to serve as foils to the four specific categories.

Scoring. The response for each symbol was scored according to the meaning as defined in the Blissymbol dictionary. Subjects' responses were tallied for exact, synonymous/or related, and " other". An exact score required that the response match the dictionary's definition. If the meaning was an equivalent or closely related word to the BCI definition, it was scored as synonymous/related. The "other" category included responses that were physical descriptions of the symbol or its components, and blanks. In the final analysis of the data, the exact and synonymous/related responses were collapsed . The rationale for collapsing these response types into one was that the question asked in the present study was for naive subjects' perceptions of what the symbols represented. It was unrealistic to expect a

response that matched the BCI derivation.

Results

Transparency of Blissymbols, as reflected in the number of exact and synonymous/related responses to the symbols, turned out to be related to their representativeness and concreteness values. A two factor analysis of variance yielded significant effects of symbol representativeness, $F(1,19)=306.39$, $p < .001$; label concreteness, $F(1,19)=80.78$, $p < .001$; and their interaction $F(1,19)=107.17$, $p < .001$. Newman-Keuls analyses showed that all pairwise differences were significant, except for the difference between LRLC and LRHC. Thus, symbol transparency decreases as a function of the stimulus attributes, such that $HRHC > HRLC > LRHC \gg LRLC$. It would appear that the R attribute has the stronger influence on symbol transparency. This judgment is based upon the finding that, with the exception of the responses to the HRHC symbols, the largest percentage of symbol responses were scored as "other".

Reliability of the Representativeness Attribute

The final study of the preliminary series (Yovetich and Lobb, 1981) was designed primarily to provide information on the intergroup reliability of the representative ratings obtained in the original (Yovetich & Paivio, 1980) studies. Forty subjects were drawn randomly from both the university and community at large and asked to rate 175

Blissymbols on the degree to which they represented their word referents. One hundred and twenty-nine of these symbols were a representative portion of the 303 symbols from the original Yovetich and Paivio (1980) study. Forty-six new symbols were added to prevent clusters of symbols from the original study.

Ratings, made on a seven point equal interval scale with one being poorly representative and seven highly representative, varied from 1 to 7 indicating that the full range of values had been used. The overall mean was 3.93, compared with a mean of 3.55 for their 1980 matches. Correlational analysis revealed $r=0.78$ ($df=127$) between the mean representativeness scores for the 129 symbols common to the two studies.

The values of representativeness for the 129 symbols were compared with the Paivio et al. (1968) values for concreteness and imagery. As in the earlier study, significant but low positive correlations between representativeness and concreteness ($r=.15$) and imagery ($r=.29$) were found. These results were similar to those reported in the Yovetich and Paivio (1980) study.

The above studies evaluated the dimensions of representativeness of symbols in relation to their written concepts. In all the studies it was found that a symbol could be highly representative (HR) or relatively unrepresentative (LR) of either a concrete or abstract word. This finding means that it may be possible to vary

the representative value and concreteness of symbols independently in experimental studies with Blissymbols. It was desirable, however, to first measure another variable, the imagery value of the symbol, and determine its relationship to representativeness. This was done in two norming studies, which also met a need for a larger corpus of symbols.

IMAGERY AND REPRESENTATIVENESS RATINGS FOR 464 SYMBOLS

Study # 1 Representativeness Ratings

The purpose of this study was to collect representativeness ratings on a larger number of Blissymbols, some of which were common to the original Yovetich and Paivio (1980) pilot study, and to the Yovetich and Lobb (1981) validation study. It was anticipated that the larger number of rated symbols would permit construction of lists without the redundant configurations occurring within compound symbols. This redundancy of some simple symbols within complex configurations, especially within the LRHC and LRLC lists, was believed to have affected the results in the (Yovetich & Paivio, 1980) paired -associates learning studies.

Method

Procedure. Forty volunteer subjects (20 males), naive to Blissymbols, were randomly chosen from the university population. Subjects were between the ages of 18 and 27 with a mean age of 21.5 and median age of 21. They were tested in a quiet setting either individually or in small groups of one to three subjects over two testing periods. Each subject was given a test booklet and written

instructions to "rate a list of symbols as to the degree of relationship between a symbol and a corresponding word" (see Appendix B for a detailed description of the instructions to subjects). Items were rated on a seven-point equal interval scale. A judgement of 1 indicated a symbol low in representativeness, whereas a rating of 7 indicated a symbol highly representative of the meaning of the word.

The two test booklets were composed of ten pages each. Each page contained 24 symbols, except for page 10 of each booklet, which contained 16 and 17 symbols, respectively (see Appendix B). Together, the two booklets included 465¹ symbols. The seven-point scale on which subjects rated each symbol's representativeness (R) value was placed to the right of the symbol. The first nine pages of each booklet were collated in multiple ways to control for contextual and practice effects. Page 10 of each booklet contained subject information and was always presented last. Presentation order of the test booklets was alternated across subjects.

¹ The symbol-word pair for "storeroom" occurred twice in the protocol and, since there was no significant difference between the two scores (i.e., 1.93 vs 2.03) one score was randomly eliminated.

Results

The resultant mean ratings of the 464 symbols ranged from 1.28 to 7.0, indicating that the full range of the scale had been used. The overall mean was calculated to be 2.97, lower than the 3.4 mean in the original Yovetich and Paivio (1980) study. The ratings for R were grouped at the low end of the scale, with 60% being rated equal to or less than 3.0, and only 10% being rated 5.0 or higher.

Forty pairs of words (synonyms), each pair represented by the same symbol, were used to test the within subject reliability. A correlation between the two sets of words was found to be .97, indicating that the reliability of the ratings was satisfactory.

An independent t-test was calculated for R across subjects to examine sex differences in symbol rating. The results indicated no significant difference between the means of male and female ratings for R value, $t[38] = 0.62$.

The mean symbol R values of the 175 items (129 matched symbols plus 46 foils) from the Yovetich and Lobb (1981) study correlated .94 with the same items in the present study. This correlation was higher than the .78 reported between the Yovetich and Paivio (1980) values for R and the Yovetich and Lobb (1981) values.

The second (cf. Yovetich & LaFlamme, 1982) of the two studies was designed to provide imagery values for 464 Blissymbols which had been rated on the dimension of representativeness. The selection of the imagery attribute,

as opposed to concreteness, was based on the assumption that pictographs representing concrete verbal concepts are by definition concrete themselves, and that ideographs that represent abstract verbal concepts are similarly abstract by definition, so that it was not necessary to collect concrete values on the symbols. However, concrete and abstract symbols could vary in their capacity to evoke imagery and it was important to determine the extent of this relationship because imagery value has been shown to be a strong predictor of memorability and other reactions to stimuli.

Study # 2 Imagery Ratings

Method

Forty volunteer subjects (20 males and 20 females) naive to Blissymbols were selected from a university population. They were between the ages of 18 and 25 with a mean age of 21 and median age of 20. The subjects were tested in a quiet setting either individually or in small groups over two testing periods. Each subject was given a test booklet (the organization of the booklets were identical to those used in the preceding representativeness study) and written instructions to "rate a list of symbols as to the ease or difficulty with which they arouse mental images" (see Appendix B). Items were rated on a seven-point equal interval scale. A judgement of 1

indicated a symbol low in imagery, whereas a rating of 7 indicated a symbol with high imagery value. Subjects were encouraged to ask questions before proceeding with the test. They were also instructed not to look back at previously rated symbols.

Results

The mean imagery ratings of the 464 symbols varied from 1.78 to 6.90, indicating that the full range of values had been used. The overall mean was 2.96. The results were grouped toward the low end of the rating scale, with 68.17% of symbols given a mean imagery rating of 3 or less, and only 12.26% given an imagery rating of 5 or more. In the earlier Yovetich and Lobb (1981) study, 28.7% of the symbols were given representativeness ratings of 5 or more. In addition, results indicated that the percentage of symbols with combined mean representativeness and imagery values of 3 or less was 6.67% and of 5 or more 7.74%.

Within subject reliability was based on the same 40 repeated items used in the representativeness study. The correlation between the means for these items was .93. Reliability ratings can, therefore, be considered satisfactory.

The imagery values were correlated with the values for symbol representativeness and the Paivio et al. (1968) values for word imagery. Blissymbol representativeness values correlated moderately ($r = 0.60$) with their imagery

values and less strongly ($r=0.30$) with the imagery values of the corresponding concepts ($df= 462$, $p < .01$, for both correlations). Additionally, a low positive correlation was found between imagery values for Blissymbols and word imagery ($r= .18$). Also, an independent t -test, indicated that male ratings ($\bar{x}= 4.23$) and female ratings ($\bar{x}= 4.33$) of imagery did not differ significantly, $t(38)= -0.620$).

Discussion

Representative values for Blissymbols were more highly correlated with imagery values of symbols than with imagery values of the written concept. This relatively moderate correlation ($r= .60$) between representativeness and imagery values of Blissymbols may be a result of the two scales measuring a "portion" of the same variable. Paivio et al. (1968) found imagery and concreteness values of words to be highly correlated (.83) and suggested that these scales were essentially measuring the same variable. Though the magnitude of the present correlation is not as large as Paivio's, it is sufficiently large to suggest that representativeness and imagery value of symbols may not be separable for the purposes of analysis.

LEARNING AND MEMORY EXPERIMENTS

The studies reviewed thus far did not include manipulation of stimulus characteristics directly to test their effects on learning or memory. This chapter describes four studies that address the effects of stimulus attributes on learnability and memorability of Blissymbols.

Learnability: Paired-Associate Learning (PAL)

The first experiment (Yovetich & Paivio, 1981), varied the attributes of Blissymbols in a paired-associates (PAL) recall task. The results of the incidental learning task (Yovetich & Paivio, 1981) described earlier revealed that symbols rated high on representativeness and representing concrete nouns, were recalled better than other combinations of the two attributes in relatively short term (STM) and relatively long term (LTM) memory tasks. This finding prompted the following experiment using a paired-associate paradigm.

Method

Design. The attributes of representativeness (R) of the stimulus symbol and concreteness (C) of the response word were orthogonally varied on two levels, high (H) and

low (L), corresponding to a two-factor randomized block design with subjects as a random factor, and experimental conditions as within subjects fixed factors (Kirk, 1968). The design also included two retention intervals, referred to here as STM and LTM conditions.

Subjects. Twenty-four University of Western Ontario students (12 male) were selected from the Health and Social Sciences faculties. They ranged in age from 18 to 24 years, ($\bar{x}$ = 19.8, mdn = 19.5), and had no prior knowledge of Blissymbols or the experiment.

Materials. Slides of the symbols matched with their word referents were constructed using the items from the Yovetich and Paivio (1981) norms. The slides were randomly ordered within four blocks of sixteen items corresponding to one of four levels; HRHC, HRLC, LRHC, and LRLC.

Procedure. The same subjects participated in both STM and LTM conditions and were tested individually in a quiet room. On the study trial, the symbol-word pairs were presented in the form of slides projected on a screen at 5-second intervals. In the STM test trial, the presentation of the list to be learned was followed by a 10 to 15-second interval after which the symbols, re-ordered from the learning sequence, were presented singularly at 8 second intervals as stimuli during which time the subject was required to respond verbally with the name of the symbol. The long-term memory (LTM) test followed after eight days of the learning trial and followed the same

testing procedures as in the STM condition. That is, the 64 stimulus symbols were presented in a new random order at eight-second intervals for the subject's response.

Results

An independent t-test analysis was first conducted to determine whether the responses of males and females were different from each other under STM and LTM conditions. No significant differences were found between the two groups and therefore sex was not incorporated as a factor in the rest of the analyses.

The mean recall scores for STM and LTM conditions are shown in Figure 5. It can be seen that in both conditions highest recall was for concrete words whose symbol referent was highly representative, while lowest recall was for abstract words whose symbol referent was low in representativeness.

The analysis of the results for the STM condition yielded significant main effects for both representativeness of the stimulus symbol, $F(1,23)=84.29$, $p < .001$; and concreteness of the response word, $F(1,23)=266.14$, $p < .001$. The interaction was not significant. In contrast, the LTM condition revealed significant F 's for all three effects: representativeness, $F(1,23)=351.03$, $p < .001$; concreteness, $F(1,23)=305.95$, $p < .001$ and the interaction, $F(1,23)=48.75$, $p < .001$. Paired comparisons of the LTM results, using Newman-Keuls, revealed significant differences ($p < .05$) between all

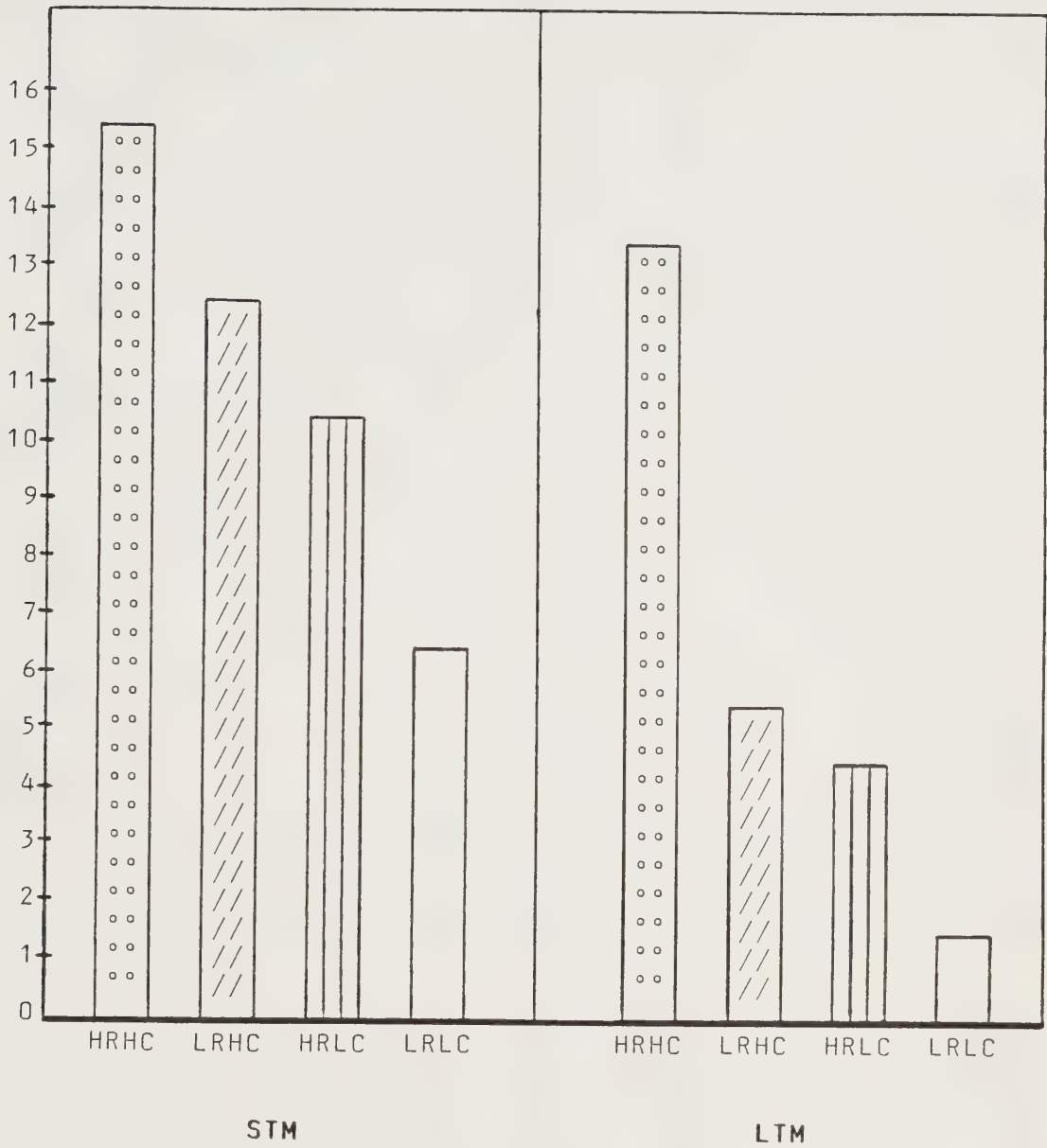


Figure 5: Mean Recall Scores for STM and LTM Conditions:
Significance was found between all but the HRLC-LRHC
Lists in the LTM condition

conditions except between high representative-low concrete (HRLC) pairs and low representative-high concrete (LRHC) pairs (see Figure 5).

Discussion

The paired-associates study manipulated stimulus characteristics of symbol representativeness and word concreteness directly to study their effects on one trial learning. The two attributes were found to have an interactive effect on learning only for the LTM task and this finding may be the result of a floor effect on recall of LRLC pairs. In addition, symbol-word pairs (i.e., a total of 16 items) that did not elicit a response from 25% or more of the subjects in both STM and LTM conditions were examined and the results revealed that these symbol-word pairs came from all lists except HRHC. This finding further supports the conclusion offered in the incidental learning task that iconic or pictographic Blissymbols matched with their concrete verbal representation are more easily learned.

The results of the paired-associate learning studies should be interpreted with caution for several reasons. First, they were conducted on adults who had some university education thereby limiting any generalizations to individuals who have had some university training. Second, it is impossible to assess the degree to which interference from established representations for the concepts may have affected the results. For example,

subjects may have a representation of "Freedom" that is not consistent with the Blissymbol representation for this concept. If so, these personal representations of the concepts might interfere with the learning of the Blissymbols. This interference would be expected in particular with those symbols rated as less representative of concrete words (i.e. LRHC) which would be expected to have previously established associations between verbal and non-verbal representations. Third, items used in the paired-associate experiment were drawn from the corpus of symbols whose representativeness values were obtained in the initial Yovetich and Paivio (1980) study. Symbol-word pairs matched for low representativeness (LR) of symbol and high concreteness (HC) of word or low representativeness of symbol and low concrete value of word were difficult to find. As a consequence, the 16 symbol -word pairs in the LRHC list included eight in which the symbol configurations had a stylized "heart" as one of its components (e.g. freedom; artist and affection). This common component probably increased the difficulty of stimulus discrimination, with the result that LRHC pairs had the lowest mean recall scores.

The next experiment used new symbols and a bipolar (H-L) manipulation of the representativeness value of the symbol. To avoid any confounding from uncontrolled interstimulus similarity, the "LR" symbols were carefully selected not to have similar components in their

construction, and to be more comparable in this respect to the stimuli in other pair types.

Learnability: Effects of Modality and Stimulus Attribute

One goal of this experiment (Yovetich & McBride, 1984) was to determine whether Blissymbol learning was affected by the presentation modality (visual versus auditory) of the word that represented the meaning of the symbol. A second purpose was to test the replicability of the effect of representativeness value of the symbols on the learning of associations between symbols and their corresponding verbal labels.

Method

Subjects. Forty volunteer subjects (20 males), naive to Blissymbols, were selected from the community and university populations. Ages ranged from 19 to 26 years ($\bar{x}$ = 22.3, mdn = 22.0). All subjects had at least grade 12 education, and some were attending university. The subjects were randomly assigned to one of two groups. All subjects reported normal hearing and visual acuity.

Materials. Sixty Blissymbols were selected from the Yovetich and Paivio (1982) representativeness ratings for 464 symbols. The sixty Blissymbols (30 high R and 30 low R) were randomly divided into two lists, each containing equal numbers (15) of randomly ordered high and low R symbols. The symbols in both lists were paired with either written or spoken word referents (i.e., List A-written,

List A-spoken; List B-written, List B-spoken).

Procedure. Each subject was presented the 60 slides of symbol-word pairs, 30 under each of the two presentation conditions. In the visual (word written) condition, the subject saw the symbol and read the word referent paired with it. In the auditory (word spoken) condition the subject saw the symbol and heard the verbal referent spoken over headphones. The items in list A were always presented first to each subject with modality of presentation varying by group. Table 2 shows the order in which the two experimental conditions were presented to the two groups of subjects. The subjects, tested individually, were told to read the instructions and ask any questions they had before beginning the test. The first thirty slides were then presented under the appropriate condition for the subject's group. The subjects were then presented the re-ordered symbols alone, and asked to name the concept that they had either seen or heard with the specific symbol. Each slide was in view for 6 seconds. After the first condition had been tested, a delay of two minutes was introduced before the second experimental condition was presented and tested. The experimenter recorded the responses (as either correct or incorrect) on a recording sheet.

Results

The data were analyzed using a three factor (2x2x2) split plot design (order x modality x representativeness). The results revealed no difference in recall of items based

Table 2

Presentation order for the two experimental conditions

(Yovetich and McBride, 1984)

Group	List	First Condition	Second Condition	List
One	A	Visual Word (written)	Auditory Word (spoken)	B
Two	A	Auditory Word (spoken)	Visual Word (written)	B

on presentation modality. The analysis of variance revealed that the only significant main effect was for representativeness, $F(1,38)=246.24$, $p < .001$. There were no interactions with R value or between the other variables. Comparisons between the recall of the HR versus LR symbols revealed that subjects recalled slightly more than twice as many HR as LR rated symbols. This result was consistent with the results of the earlier studies. The lack of a modality effect on learning suggests that the two modes of presentation are equivalent and that future experiments, with subjects who are unable to read traditional orthography (i.e., preschool or handicapped adults), could use symbols paired with spoken words.

To summarize thus far, nine studies were carried out to test the psychological reality of the nominal relationship between Blissymbol and word/meaning. The previous studies were designed to collect rating norms to determine how representative Blissymbols are of the concepts they are supposed to represent; to determine relations of these ratings to other relevant attributes; and to study learnability of the concept names as a function of Blissymbol representativeness (R) and word concreteness. The results of these studies have revealed a low positive correlation between representativeness of the symbol and the word attributes of concreteness, imagery, familiarity and frequency of occurrence, and a moderate correlation

with symbol imagery. Further it was shown that, in a paired- associates learning task, symbols representing concrete concepts were the easiest to recall. Finally, HR symbols were shown to be recalled slightly more than twice as easily as LR rated symbols. This information allowed one to now test whether the conceptual nature of the symbol concretized abstract concepts and thus enhanced their memorability. This last question was addressed in the next two experiments to be described.

Memorability Studies: Elaboration and Generation Effects on Recall of Blissymbol Concepts

The two experiments reported here investigated the memorability of Blissymbols using a procedure patterned after one used in a series of experiments by Paivio and Lambert (1981, 1984). In the first of two experiments, Paivio and Lambert (1981), had French-English bilinguals code a mixed list of sequentially presented pictures, French words, and English words, by writing the English names of the pictures, translating the French words to English, and copying the English words. The participants were then asked unexpectedly to free recall the English words they had generated. The second experiment reversed the coding task in that bilinguals were presented only English words along with coding cues that prompted them to sketch the referents of one-third of the items, translate

another third into French, and copy a third. The incidental memory test in this case required the participants to free recall the English stimulus words. The assumptions of dual coding theory led Paivio and Lambert (1981) to predict that recall in the picture-naming and word-image condition would be more than twice the level of recall in the monolingual copy condition. In addition, Paivio and Lambert hypothesized that bilinguals have two mnemonically independent linguistic memory stores, and that coding by translation therefore should result in an additive effect on recall. Though this recall for translated words should be higher than recall for unilingual copied words, the level of recall for translation should be lower than for picture naming (or word imaging), "because the latter profits from the [previously demonstrated] mnemonic superiority of the image code whereas bilingual coding presumably engages two verbal codes of equal mnemonic value" (Paivio & Lambert, 1981 p.533). The results of the two studies were consistent with these predictions.

In two studies, Paivio and Lambert (1984) dropped the picture naming condition and had bilingual subjects encode each item of a mixed list of concrete and abstract nouns in one of two ways. The first study (a generation condition), required the subjects to encode the word presented by translating it from French to English, or by generating a same-language (English) synonym, or simply writing down the

item, according to a spoken coding cue that accompanied each item. The second study was an elaboration condition in which subjects were presented the stimulus words in English and were required to translate them into French, with the synonym and copy tasks remaining the same as they were in the generation condition. The subjects in the generation condition were asked to free recall all the English words they wrote down (response items), whereas the subjects in the elaboration condition were asked to recall the stimulus words presented in English. The results indicated that there were no significant differences between translation and synonym recall scores for the generation and elaboration conditions. No difference between translation and synonym production tasks suggests they are equivalent cognitive tasks. This assumption is important to the study of Blissymbol memorability because it permits an experiment to be done combining the picture-word (or word-image) conditions of Paivio and Lambert (1981) and the synonym coding condition used in the later (1984) study. The rationale is developed below.

A parallel to Paivio and Lambert's (1981) findings of picture naming superiority was suggested by the Yovetich and McBride (1984) report of more than two fold superiority in recall for HR over LR Blissymbols. If one extends the arguments from the Paivio and Lambert research to the Yovetich and McBride results, then the HR Blissymbols paired with their nominal representation were processed

functionally as if they were picture-word pairs. The analysis implies that both verbal and nonverbal systems were activated, with additive effects on recall of the HR symbols. That is, the more than two fold difference in recall between HR and LR Blissymbols suggests that the HR symbol-word pairs were processed as if they were picture-word combinations, whereas the LR symbol-pairs were processed as if they were word-word pairs.

A modification of Paivio and Lambert's paradigm presents a useful model for investigating the above suggestions and related hypotheses concerning the memorability of Blissymbols. For example, Paivio and Lambert (1981) demonstrated that recall of items from a picture-word presentation significantly exceeded recall of items from a French-English (and vice versa) translation, which in turn exceeded the unilingual word copying task. The results of their unpublished study demonstrated that there was no significant difference in recall between bilingual translation and unilingual synonym production tasks. Therefore, to test for any parallel in processing between pictures and Blissymbols, the symbols could be substituted for pictures and combined with the synonym production and word copy tasks. In this way, the predictions made in the Paivio and Lambert studies could be extended to Blissymbols. For example, if the Blissymbol-word pairs were processed as in a picture-naming task then one would predict recall of these items to be

greater than recall of items in a synonym task, which in turn would exceed recall of copied items. Furthermore, a prediction that can be made using Blissymbols, but not familiar pictures, is that if all symbols are processed in a manner that is functionally similar to picture processing, then any recall increment resulting from dual symbol-word coding should be equivalent for symbols that represent concrete and abstract words. The implication is that the symbols would concretize the concepts named by abstract words. In addition, recall of items for the synonym and copy tasks should show the usual superiority of concrete words over abstract words.

Two other extensions were suggested by the previous research. First, Yovetich and McBride (1984) reported significant differences between the recall of HR and LR Blissymbol-word pairs, so the R value of symbols was varied in the experiments. Second, generation and elaboration conditions paralleling those used in the Paivio and Lambert studies were included in order to test the generality of any effects across two variants of the basic design.

In summary, two experiments were conducted to explore whether conceptually based ideographs (i.e., Blissymbols) are processed in a manner that is functionally similar to picture processing, thereby concretizing abstract concepts and activating dual processing. The expected results, based on dual coding theory and on previous research by Paivio and Csapo (1973), Paivio and Lambert (1981), and

Yovetich & McBride (1984) were as follows: (a) a progressive increase should be found in recall of the elaborated words from copy to synonym to symbol-drawing tasks (i.e., if Blissymbols are processed functionally like pictures); (b) words associated with HR symbols in both symbol-naming and symbol-drawing tasks (regardless of word imagery values), should be recalled better than those associated with LR symbols, and both HR and LR recall should exceed recall of copied items; (c) a significantly higher recall of items should be found for the symbol-drawing and symbol-naming tasks than for the synonym coding task because the drawing and naming tasks activate nonverbal as well as verbal processing; (d) recall of abstract words generated from LR symbols should be lowest for both generation and elaboration conditions; and (e) recall of concrete words generated from LR symbols should be higher than abstract words generated from LR symbols (Yovetich & Young, 1983).

General Method

Design. Four combinations of symbol R and word I were used to construct three lists of symbols and words that were used in both experiments. The items selected were symbols and their word referents rated as high symbol R-high word imagery (HRHI), high symbol R-low word imagery (HRLI), low symbol R-high word imagery (LRHI) and, low symbol R-low word imagery (LRLI). The design of the two studies (with the exception of the modifications necessary to accommodate the substitution of Blissymbols) closely

paralleled the Paivio and Lambert (1981) study. Blissymbols were used in elaboration and generation conditions similar to picture-naming and image-drawing procedures. The other coding conditions were synonym generation and word copy as in Paivio and Lambert (1984).

Symbols were selected with imagery ratings equivalent to their R values because it was difficult to separate symbol I and symbol R ($r=.60$ $df=462$) for analytical purposes. Similarly words with high synonymity ratings were selected to make certain the task would be sufficiently difficult during encoding to insure subjects would not be able to engage in behaviours other than those they were instructed to carry out.

Subjects. Twenty-four subjects (age range from 23 to 55, $\bar{x}=34$) were selected from a list of individuals who had successfully completed the BCI training program on Blissymbol use. The selection criteria included daily use of and ability to read Blissymbols. The twenty females and four male subjects were randomly assigned to one of two groups to be used in the two experiments.

Materials. Three separate lists of sixteen symbol-word pairs, each orthogonally varied on symbol representativeness and word imagery, were constructed. Each 16 item list contained 4 symbol -word pairs in each of four combinations, high symbol representativeness-high word imagery (HRHI), high symbol representativeness-low word imagery (HRLI), low symbol representativeness-high word

imagery (LRHI) and, low symbol representativeness-low word imagery (LRLI). The items were selected from the Yovetich and Paivio (1982) norms. The final lists included only those words that had a high (and equal) probability of generating a synonym in a synonym generating task (i.e., 80% probability or higher). Synonymity values, defined generally as the degree of similarity of meaning between pairs of words, were obtained from the Whitten, Suter, and Frank (1979), Wilding and Mohindra (1981), and Clark (1984) norms. These norms were generated by having subjects rate pairs of words on equal interval scales (e.g., 1 to 7) with one representing low synonymy or similarity in meaning and seven representing highly similar in meaning or synonymous.

The three lists were randomly arranged into a basic 48 item list to allow for counterbalancing of tasks. Table 3 schematizes the counterbalancing of lists and task ordering for subjects. One third of the subjects were randomly assigned to receive the three tasks (draw/name, synonym, copy) with Lists A, B, and C respectively. Then, one third were assigned to receive the three tasks with Lists B, C, A respectively and, one third were assigned to receive the three tasks with Lists C, A, B (see Table 3). For example, in the elaboration condition if a word was used to generate a symbol in list A for one third of the subjects, it was then used as a word to generate a synonym for a third of the subjects and, as a word to be copied by one third of the subjects. In the generation condition, if a symbol was

Table 3a

List and task ordering for the elaboration condition

SUBJECTS	TASK	LIST
1/3	DRAW	a
	SYNONYM	b
	Copy	c
1/3	DRAW	b
	SYNONYM	c
	Copy	a
1/3	DRAW	c
	SYNONYM	a
	Copy	b

Table 3b

List and task ordering for the generation condition

SUBJECTS	TASK	LIST
1/3	NAME	a
	SYNONYM	b
	Copy	c
1/3	NAME	b
	SYNONYM	c
	Copy	a
1/3	NAME	c
	SYNONYM	a
	Copy	b

used as a stimulus to be named in List A for one third of the subjects, its word referent was used to generate a synonym for one third of the subjects and, as a word to be copied by one third of the subjects. (see Appendix E-4 for stimulus materials and presentation order).

Analyses. To facilitate comparison between the present data and that of Paivio and Lambert (1981, 1984), the generation and elaboration conditions were analyzed separately and then together. In addition, a systematic procedure of analyses was carried out to satisfy several a priori questions. For example, an analysis was first performed to determine whether there was a list effect. Next, the conditions were analyzed to determine whether there was a representativeness effect on memory. Finally, the data were collapsed into concrete -abstract levels for the remainder of the analyses, some of which were a priori pairwise comparisons.

Elaboration Experiment

Procedure. Subjects were tested either individually or in pairs, with instructions and procedures modified from the Paivio and Lambert (1981) elaboration study. The subjects read and heard the following instructions:

A series of words will be presented on the screen, one at a time. Before each word appears, you will be asked to process it in one of three ways. In one case you

will be asked to draw the Blissymbol that represents the word. For example, if the word were "mother", you would quickly construct the symbol which represents "mother". No need to be template correct in your drawing of the symbol, a construction sufficiently clear to indicate you know the symbol is all that is required. In the second case you will be asked to generate a synonym to the presented word and write it down. For example, if the word were boat you might write down ship. In the third case, you will be asked to simply copy the word presented. For example if the word were raincoat, you would write the word down in the appropriate space provided. I will tell you before each change of slide which process to perform by saying, DRAW; GENERATE A SYNONYM; or COPY. Please work quickly as the words will be presented at a relatively rapid rate. The quality of writing or symbol construction is not important to the task.

To summarize, you will have three different tasks to perform, either drawing a symbol, writing down a synonym to the stimulus word or copying the presented word in the spaces provided on the page.

The subjects were then given a demonstration of the type of stimuli they would be seeing and their presentation speed. Their questions were answered and the experiment began.

Paivio and Csapo (1973) demonstrated that exposure and attention intervals could affect differential attention to different kinds of stimuli. Therefore, the slides were presented at 6-second intervals, with an exposure duration of approximately 100 milliseconds per slide. The interval allowed for completion of encoding responses and the short exposure controlled for differential attention to the different kinds of stimuli. The duration was programmed onto the control audio tape of the Caramate 3300 slide projector. The sound of the slide changing served as a warning followed by the verbal instruction and finally presentation of the slide. Subjects were required to write their responses on numbered sheets supplied by the examiner. These sheets were removed prior to the unexpected recall task that followed the presentation of items. The subjects were asked at this time to recall, in any order, all the words they had seen on the screen. They were also asked whether they had expected the recall task. After the recall task, the subjects were presented a new sheet containing the symbols paired with their word referents and asked to rate the symbols on the degree to which they represented their word match (see the previous section for details of rating procedure).

Results

The responses in the elaboration condition were scored as correct if subjects correctly recalled the stimulus words that corresponded to the conventional dictionary

meanings of the symbols. An initial analysis revealed that there was no list effect so the data were analyzed using a three factor, Task X Symbol R X Word I (3x2x2) repeated measures design. The three factors were treated as fixed.

Analysis of mean recall scores for HR and LR symbols revealed no significant differences between the two scores. In addition, representativeness did not interact significantly with imagery or the other conditions.

To determine whether Blissymbols were processed in a similar manner as picture processing, and to facilitate comparison with the Paivio and Lambert (1981, 1984) studies, the data were reanalyzed collapsing across the representativeness factor. To highlight the fact that the high imagery and low imagery levels are now confounded with differences in representativeness also, it seems meaningful to rename this factor as concreteness. Such relabelling is consistent with the terminology in this research area and is supported by the conclusion drawn by Paivio et al. (1968) that the two scales (imagery and concreteness) are measuring the same variable. Therefore, the data for HRHI and LRHI were combined to form the concrete level, while HRLI and LRLI conditions were collapsed to form the abstract level of a two factor 3x2 (task x concreteness) repeated measures randomized blocks design.

Table 4 shows that the resulting mean recall scores for the three tasks were ordered as predicted: draw ($\bar{x}=4.375$) > synonym ($\bar{x}=2.833$) > copy ($\bar{x}=1.167$).

Table 4

Mean recall scores for elaborated or generated concrete and abstract symbols/words under draw/name, synonym-coding and copy tasks (Condition x Level x Task)

	ELABORATION		TASK	GENERATION		TASK
	Concrete	Abstract	$\bar{X}$	Concrete	Abstract	$\bar{X}$
Draw/Name	4.500	4.250	4.375	4.667	3.333	4.000
Synonym	3.417	2.250	2.833	2.667	2.333	2.500
Copy	1.500	0.833	1.167	1.333	0.667	1.000
Level						
$\bar{X}$	3.139	2.444	2.792	2.889	2.111	2.500

Furthermore, task was the only significant effect revealed by the analysis of variance, $F(2,22) = 61.7917$, $p < .0001$. A a priori analysis revealed that all pairwise differences were significant. Because of the a priori expectation that there should be no significant difference between concrete and abstract levels for the draw condition if the symbols concretized abstract concepts, the mean recall for concrete and abstract words, elaborated by the three tasks, were analyzed using correlated t-tests. The results were consistent with the prediction in that pairwise comparisons revealed no difference between recall of concrete and abstract words for the draw task but a significant difference between the concrete and abstract levels of synonym production. The means for the copy task, also expected to differ, were low (concrete = 1.500; abstract = 0.833), which may have been due to a floor effect precluding the usual difference between concrete and abstract items reported in earlier studies (Paivio & Csapo, 1973; Paivio & Lambert, 1981).

Generation Experiment

Procedures. Subjects were tested either individually or in pairs, with instructions and procedures modified from the Paivio and Lambert (1981) elaboration study. The subjects read and heard the following instructions:

A series of words or symbols will be presented on the

screen, one at a time. Before each word or symbol appears, you will be asked to process it in one of three ways. In one case you will be asked to name the Blissymbol presented. For example, if the symbol were "mother", you would quickly write down "mother". In the second case you will be asked to generate a synonym to the presented word and write it down. For example, if the word were boat you might write down ship. In the third case, you will be asked to simply copy the word presented. For example if the word were raincoat, you would write the word down in the appropriate space provided. I will tell you before each change of slide which process to perform by saying, NAME; GENERATE A SYNONYM; or COPY. Please work quickly as the slides will be presented at a relatively rapid rate.

To summarize, you will have three different tasks to perform, either naming a symbol, writing down a synonym to the stimulus word or copying the presented word in the spaces provided on the page.

The subjects were then given a demonstration of the type of stimuli they would be seeing and their presentation speed. Their questions were answered and the experiment began.

Results

The responses in the generation condition were scored as correct if they corresponded to the labels and synonyms generated during the encoding task. The rest of the

analyses were the same as for the elaboration experiment.

Initial analysis revealed no significant difference between HR and LR symbols and these ratings had no effects alone or in interaction with word imagery or other conditions. Word imagery was found to be significant, $F(1,11) = 7.434$, $p < .02$. However, it had no effects in interaction with other conditions. The data were collapsed, as in the elaboration experiment, and reanalyzed as a task x concreteness (3x2) repeated measures randomized blocks design with task and concreteness level as fixed factors.

Results of the reanalysis supported the prediction that mean recall would increase from copy to synonym to symbol naming task. Table 4 shows that mean recall of items from symbol naming ($\bar{x} = 4.000$) was four times that of copy ($\bar{x} = 1.000$) whereas synonym generation performance ($\bar{x} = 2.500$) was more than twice that of the copy task. In addition, mean recall was significantly higher for concrete items. Analysis of variance revealed significance for both experimental conditions: Task, $F(2,22) = 26.206$, $p < .0001$; and concreteness, $F(1,11) = 7.434$, $p < .02$. Comparisons using a priori analysis revealed a significant difference between concrete and abstract items for the naming task. This finding was inconsistent with the prediction that a difference was to be expected between concrete and abstract items for synonym and copy tasks but not naming. These findings were also different from the results reported for

the elaboration condition. The only similarity between the elaboration and generation conditions was the low recall scores for the copy tasks, which appeared to be the result of a floor effect.

Generality of effects. The elaboration and generation conditions were selected to examine the generality of effects across variants of the basic design. Therefore, the data from both experiments were analyzed together, with generation and elaboration conditions as factors. The analysis of variance was a 3x2x2 repeated measures split plot factorial design (task x concreteness x condition). The analysis of variance revealed significant differences for task, $F(2,44)=67.471$, $p < .0001$; and for concreteness, $F(1,22)= 9.276$, $p < .006$. There was no significant difference between elaboration and generation conditions and all other comparisons were consistent with the findings of the independent experiment analyses.

The data were reanalyzed conditionalizing on correct and incorrect encodings in an attempt to determine whether the difference in results between conditions was due to the recall demands of each condition. The first analysis was performed on mean percent recall of correct encodings using a 2x2x3 split plot factorial analysis of variance. The factors were generation versus elaboration encoding conditions (between subjects), concrete versus abstract symbol/words and the name/draw task versus synonym and copy tasks. Significant results were obtained in the overall

analysis for concreteness and task. The mean percent recall scores are presented in Table 5. The data and analysis showed: (a) percentage recall was higher for concrete than for abstract items, $F(1,22) = 13.433$, $p < .001$; and (b) recall increased from copy to synonym to name/draw tasks, $F(2,44) = 54.794$, $p < .0001$. Although concreteness did not interact with any of the other variables, it would appear from Table 5 that the main effect is attributable to the naming task in the generation condition and the synonym task in the elaboration condition. This impression was supported by a priori analysis using correlated t-tests between the mean percent recall for each task. These results were essentially the same as the unconditionalized analyses and suggest that differences in the results were not due to the correctness of encoding.

The second conditionalized analysis was carried out on mean percent recall of "different" encodings for the generation and elaboration conditions. The analysis was similar to the correct encoding analysis except that it was a $2 \times 2 \times 2$ (condition $\times$ concreteness $\times$ task) split plot factorial design. The task became two levels as the copy task was dropped because encoding was virtually always correct. The mean recall scores are presented in Table 6. The data and analyses revealed that recall for concrete items was higher than for abstract, $F(1,22) = 17.983$, $p < .0003$. Furthermore, a three way interaction existed between condition, task and, concreteness, $F(1,22) = 7.137$, $p < .01$.

Table 5

Mean percent recall scores of correctly encoded items for
elaborated or generated concrete and abstract symbols/words
under draw/name, synonym-coding and copy tasks

=====				
TASK	ELABORATION		GENERATION	
	Concrete	Abstract	Concrete	Abstract
Draw/Name	61.00	50.25	71.58	44.25
Synonym	49.17	24.42	42.83	19.33
Copy	13.67	10.13	16.42	8.08
=====				

It would appear, from examining Table 6, that the interaction was due to the elaboration condition. Separate analyses for the two conditions supported this last impression by the finding of an interaction between task and concreteness for the elaboration condition, $F(1,11)=5.589$, $p < .04$, but not for the generation condition, $F(1,11)=1.595$. Newman-Keuls pairwise analysis of the elaboration condition revealed that recall was higher for concrete words (in the synonym task) than for abstract words. Further examination of the data in Table 6 shows that recall was the highest, overall, for the synonym task in the elaboration condition. In addition, the trend was observed that abstract words, elaborated by the symbols, were more readily recalled than concrete words similarly elaborated. This finding suggests that the idiosyncratic "different" encodings may have been ones that were more concrete or representative to the individuals who constructed them.

Consistent with the predictions (see page 50), the results showed (a) a progressive increase in recall from copy to synonym to picture-drawing/naming tasks; (b) equivalent recall of concrete and abstract words elaborated by symbols (elaboration condition only) and, (c) superiority of recall for concrete over abstract words in the synonym-coding task (significant only in the elaboration condition). In addition, trends were found in the direction of diminished recall of abstract words

Table 6

Mean percent recall scores of differently encoded items for
elaborated or generated concrete and abstract symbols/words
under draw/name, synonym-coding and copy tasks

=====				
TASK	ELABORATION		GENERATION	
	Concrete	Abstract	Concrete	Abstract
Draw/Name	44.50	49.17	67.25	31.67
Synonym	61.50	23.00	50.58	29.83
=====				

generated from LR symbols in both experimental conditions, and higher recall of concrete words versus abstract words generated from LR symbols. Also, the generality of effects was not substantiated by the finding of a significant difference between concrete and abstract words generated by symbols in the generation condition.

GENERAL DISCUSSION

The general discussion is organized in terms of the three main aspects of the thesis: (a) the degree to which Blissymbols represent their word labels, (b) the effects of the psychological attribute of symbol representativeness (R) on learning and memory, (c) the degree to which Blissymbols are processed in a manner functionally similar to pictures and, (d) general implications for further cognitive and applied studies.

Representativeness

The psychological attribute of representativeness, defined as the degree to which the symbols represented their word referents, was selected for study, because Bliss, (1965) asserted that Blissymbols disambiguated vague or abstract meanings and more importantly, (b) because they were proposed as a visual symbolic communication system that represented words and their meanings. However, this relationship between symbols and their word/meanings has never been tested empirically. The finding that Blissymbol representativeness ratings varied over a considerable range

is not supportive of a strong interpretation of Bliss's assertion. If the symbols were iconic representations of their word referents, one might expect ratings to vary only slightly, perhaps from moderate to high R. However, the R ratings tended to be grouped at the low end of the scale. The low (but significant) positive correlation between symbol representativeness and word concreteness/imagery ($r = .16$ and $r = .27$ respectively, $df=462$) supports the position that the relationship between symbol and meaning is not based purely upon iconicity of the symbol. However, the degree to which the meaning of a symbol is transparent to a naive subject is significantly affected by both the concreteness of the word and the representativeness of the symbol. This affect was demonstrated, in the Yovetich and Young (1983) study, by naive subjects being able to name the HRHC symbols easier than the other three levels of symbols.

The transparency of the symbols, as judged by a higher R rating, increased with the knowledge of Blissymbols and their meanings. This last judgement is supported by the finding that knowledgeable subjects rated the R value of the symbols significantly higher than naive subjects. The higher ratings may, in part, be due to the subjects analyzing the symbols as part of the rating process. Therefore, the clarity in understanding would appear to increase with knowledge of Blissymbols and their meanings.

This knowledge allows one to decode the structurally complex symbols into their more meaningful component parts.

Effects of Representativeness on Learning and Memory

Learning

The paired -associates learning task (Yovetich & Paivio, 1981) and the stimulus modality study (Yovetich & McBride, 1984) demonstrated that the degree of representativeness had an effect on learning. This finding is important in the light of a recently published study comparing Bliss, traditional orthography and two other symbol systems (Clark, 1981). In her study, Clark selected stimulus items according to their availability in the glossaries of the systems being compared. In another study Musselwhite and Ruscello (1984) compared Bliss and two other symbol systems in a transparency or guessability task. Again, as in the Clark (1981) study, no attempt was made to compare items from the various systems matched on any psychological attribute. In fact, no reference was made in either study to the issue of attribute effects on learning. It is conceivable that the comparative studies mentioned above might have drawn different conclusions had they controlled for the effects of concreteness or representativeness of the stimuli. It was demonstrated earlier (Yovetich & Paivio, 1980; Yovetich & Young, 1983) that low R Blissymbols which represent low imagery

(abstract) words are hardest to learn and least transparent for naive subjects. Analysis of the 63 different target words used by Musselwhite and Ruscello (1984) revealed 28 words (44.4 % of the target items) for which normative data were available. The R ratings of the symbol referents for these words ranged from 1.53 to 6.53 ($\bar{x}$ = 3.29, mdn = 3.02, sd = 1.51), while the imagery values for the words ranged from 1.19 to 6.67 ($\bar{x}$ = 3.98, mdn = 3.90, sd = 1.93). A correlation between the representativeness values and word imagery was .35 (df = 26). This value was consistent with that reported in the norming studies (i.e., r = .30). No normative data, on the degree of symbol representativeness, is available for the other two systems. However, it would appear the results may have been a function of the Blissymbol sample that Musselwhite and Ruscello selected. The items they used were relatively low imagery words with corresponding low representative Blissymbols. Earlier research (Yovetich & Paivio, 1981; Yovetich & Young, 1983; Yovetich & McBride, 1984) demonstrated that HR symbols were better learned than LR Blissymbols. It could be argued that had Musselwhite and Ruscello selected their items from the three systems equated on levels of representativeness, they would have obtained different results and drawn a different conclusion.

Memorability

The effects of representativeness were not as clear in the memory experiments as in the learning studies. The

lack of a significant representative effect on memory may have been due mainly to the fact that the subjects were familiar with Blissymbols, but it may also have resulted from item selection. The norming data on symbol R were collected from naive subjects (Yovetich & Paivio, 1982). These data were used because it was shown (Yovetich & Paivio, 1980) that knowledgeable subjects confound the rating task by dissecting the complex symbols into their simple parts for meaning before rating them.

Selection of items for the last two studies was also affected by the necessity to: (i) keep the symbol imagery rating consistent with the R value, (ii) find symbols that had high R and low R with either high or low word imagery values to make up the four categories and, (iii) find symbols whose word referents had synonymy ratings (or data) indicative of equal difficulty to the symbol draw/name tasks. These requirements for symbol selection resulted in HR symbols tending to be closer to a moderate R value than LR symbols ($\bar{x}_{HR} = 5.83$, $\bar{x}_{LR} = 3.87$) rather than the preferable high R value that would differentiate them maximally from LR symbols.

In regards to subjects, the mean R ratings for the group of subjects that knew the symbol system (obtained following completion of the experiment) were significantly higher than the normative ratings obtained from naive subjects ($\bar{x}$ knowledgeable = 4.85, $\bar{x}$ naive = 3.25). This latter point may have been responsible for the lack of an

interaction effect between symbol R and word imagery values.

Processing of Blissymbols

The two questions addressed by this final aspect of the research program were: (a) are Blissymbols processed like pictures? and (b) to what degree do Blissymbols concretize abstract concepts and thus enhance memorability?

The data were suggestive of the position that Blissymbols are processed like pictures. The proportions of mean recall for the tasks of draw/name, synonym-coding and copy were similar to those reported for picture (or image)-word and word-word comparisons (Paivio & Lambert, 1981, 1984). That is, recall for items from draw/name was more than three times, and synonym coding more than twice the recall of the copy task (Table 7). The superiority of recall for the draw/name task can be interpreted as being due to the mnemonic superiority of the image code whereas the synonym-coding task presumably engages two verbal codes of equal mnemonic value (Paivio and Lambert, 1981).

The consistency in the recall differences between tasks for the two conditions supports the generality of the findings across the two variants of the basic design. That is, the generation condition required subjects to recall response words generated by either symbol or word stimuli. The elaboration condition required subjects to recall stimulus words that had been elaborated upon by either

Table 7

Mean recall scores for combined elaborated and generated
concrete and abstract symbols/words under draw/name,
synonym-coding and copy tasks (Condition x Level x Task)

=====		
ELABORATION/GENERATION		
	Abstract	Concrete
Draw/Name	3.792	4.583
Synonym	2.292	3.042
Copy	0.750	1.417
Level		
$\bar{X}$	2.278	3.014
=====		

sketching a symbol, writing a synonym, or simply copying the stimulus word. Therefore, the effects of each condition on recall were due to differences in the way the target items were encoded.

The overall analysis of the generation and elaboration conditions demonstrated a concreteness effect but no interaction of concreteness by task. Analysis of the individual conditions revealed, however, that the concreteness effect was due to the generation condition (Table 4.). The results of the elaboration condition are consistent with the position that Blissymbols completely concretize abstract concepts and thereby enhance their memorability. This was revealed by the absence of any difference between the recall of concrete and abstract words elaborated by sketching their referent symbol, whereas significantly more concrete than abstract words were recalled in the synonym task. To be consistent with predictions from dual coding, a concreteness effect should have been evidenced in the copy condition. Concrete words tended to be recalled better than abstract words, but the difference was not significant, perhaps because of a floor effect.

The failure of the results from the generation condition to be consistent with those from the elaboration condition may have been caused by several factors. One factor may simply have been that a higher number of concrete symbols were named and recalled (59.4 %) than

abstract symbols (48.9 %). Also, the results for abstract symbol-words were confounded by the fact that many encodings were idiosyncratic. For example, of the 47 words recalled, 20 had been correct encodings for the symbol stimuli, 17 had been an idiosyncratic abstract encodings for the symbols, and 10 had been concrete encodings for the abstract symbol stimuli. No such response flexibility was possible in the elaboration condition because subjects were required to recall the word stimuli that they had been presented.

The lack of any difference between concrete and abstract word recall in the synonym-coding task may have been due to the fact that 41.7 % of the abstract words were coded as concrete words, which constituted 55.5 % of the words recalled. If these concrete words were removed from the results for abstract words, the percent recall is 18.7 % versus 29.2 % (before removal). This lower recall level for abstract words is substantially lower when compared to the 34.4 % recall for concrete words.

The interpretations of results in this thesis follow directly from the dual coding model and empirical data (e.g. picture superiority) associated with it. Other models and approaches might be used to provide alternative post hoc explanations. For example, an effort interpretation could accommodate the results of the generation condition in which recall was tested for the response items. However, the effort model could not

accommodate the elaboration experiment where recall involved the stimuli (i.e., generating items) themselves. A levels-of-processing interpretation might be appropriately applied to either the elaboration or generation condition, but the approach does not include any independent way of determining which of the dual coding conditions, nonverbal or verbal, requires deeper or more elaborate processing.

General Implications

Blissymbols have been in continuous use with nonvocal handicapped individuals for nearly fifteen years. Their clinical use has been extended and broadened to a variety of handicapped populations without an equivalent extension in basic research. This thesis has contributed some new information about the cognitive processing of Blissymbols. The psychological attributes of representativeness and imagery of Blissymbols were obtained through norming studies. These attributes were demonstrated to have an effect on learning, memory and perceived symbol transparency. This latter information is important in light of recently published studies comparing Blissymbols with other symbol systems. In these comparative studies no reference to symbol attributes was made in the selection criteria. Reanalysis of the data using approximately half of the items in the one study, for which normative data

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were available, revealed that the results for Blissymbol learnability would have been predicted had they used symbol attribute values in their selection. In spite of this fact, the symbols used in their experiment were appropriate samples of the degree to which Blissymbols represent their word referents. Future cognitive research and clinical comparative studies may be able to address these issues clearly, using the Blissymbol attributes obtained in the present program of research.

The main function of Blissymbols has been as a communication system. However, current trends in teaching any symbol system have used criteria which include items that might satisfy a basic or emotional need. The issue of whether the symbol is highly representative or concrete is not considered. Perhaps, given the information that the degree a symbol is perceived as representing the concept affects its learnability, future procedures will incorporate such information in the selection of items to be taught. In addition, normative information obtained in this thesis may be applied to investigate the ease of Blissymbol communication. For example, Begg et al. (1978) found that concrete words were easier to communicate than abstract. Future cognitive research might be directed towards investigating whether Blissymbols, highly representative of abstract concepts, are as easily communicated as concrete words or symbols representative of concrete verbal concepts.

Conclusions

Eleven studies were conducted as a way of studying the cognitive processing of a relatively new and invented symbol system. The program of research established the valid and reliable psychological attribute of Blissymbols called representativeness. The research program further demonstrated that the degree to which a symbol was perceived as being representative of its word referent had a positive effect on learning the symbol. The same trend was seen in respect to memory, although the effects were not significant.

In these studies, Blissymbols appear to have been processed in a manner that is functionally similar to the way pictures are processed, even in the case of Blissymbols that corresponded to abstract verbal concepts. Thus, the symbols effectively concretize abstract concepts during certain tasks. In addition, the research program has introduced the novel attribute of representativeness that should be considered in any experimental or clinical application of Blissymbols. Based upon the results of the studies reported in this thesis, it is suggested that individuals concerned with the development of Blissymbols spend time and effort towards improving the overall representativeness of the system.

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APPENDIX A

The mean ratings for the psychological attributes of 464 Blissymbols and their word referents

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
·√	ABILITY	1.33	3.25	2.03	2.67	6.26	5.60	49
>	ABOUT	1.80	4.75	.00	1.38	6.65		100
÷	ABOVE	5.18	4.25	.00	3.06	6.47		100
⊕!	ACCURATE	2.28	3.90	.00	2.53	6.06		14
⊙>>1	ADVICE	1.63	3.03	2.08	3.13	5.89	5.39	50
♥+	AFFECTION	3.58	4.18	2.18	4.87	5.64	6.36	37
♥↓?	AFRAID	1.98	2.98	.00	4.44	6.40		100
⊙ ⊙	AFTERLIFE	2.00	3.05	1.77	2.40	4.30	6.16	0
⇒	AGREEMENT	3.13	5.60	2.93	3.33	5.81	4.48	31
∟	AIR	1.58	3.75	5.67	4.17	6.77	6.36	100
⊙ ₁	ALONE	2.13	2.65	4.91	4.91	6.02		100
⊙⊗	ALWAYS	1.70	4.10	.00	1.88	6.81		100
⊗	AMBULANCE	3.98	5.68	7.00	6.67	5.39	7.52	8
×♥<<	ANGER	2.10	2.68	1.70	4.87	5.77	5.83	50
⌘	ANIMAL	3.20	5.35	6.75	6.10	6.67	7.00	100
↳	ANKLE	2.48	3.73	7.00	6.77	5.64	6.82	21
□?	ANSWER	3.90	5.85	4.49	2.77	6.61	6.04	100
♥↑↓?	ANXIOUS	2.58	3.05	.00	3.44	5.84		48

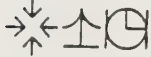
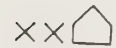
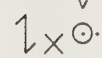
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Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	ANYONE	1.65	3.03	.00	2.31	6.45		50
	APPLE	5.15	5.35	7.00	6.73	6.43	7.67	50
	APRON	1.53	3.05	.00	5.88	5.56		17
	ARM	3.55	5.23	6.96	6.53	6.55	6.92	100
	ARROW	5.98	3.95	7.00	6.57	5.30	6.80	37
	ARTIST	2.03	2.45	6.14	5.93	5.87	6.65	50
	ATMOSPHERE	1.55	4.68	3.76	4.23	5.87	7.17	38
	AUTOMOBILE	6.03	6.85	7.00	6.87	6.04	6.16	50
	BABY	3.65	5.28	6.90	6.70	6.47	7.04	100
	BACK	2.85	3.63	.00	4.16	6.35		100
	BAD	1.53	3.00	.00	3.19	6.65		100
	BALLOON	6.18	6.38	.00	6.13	5.73		17
	BANKER	2.25	4.03	6.38	6.03	5.80	6.56	27
	BAR	2.63	3.60	6.83	6.40	6.22	6.08	50
	BATH	2.55	5.58	.00	5.75	6.53		46
	BECAUSE	2.73	3.50	.00	1.44	6.73		100
	BED	5.73	6.00	.00	6.63	6.84		100
	BELIEF	2.55	4.05	1.55	2.73	5.75	5.24	39
	BEVERAGE	2.13	4.20	5.96	5.87	6.06	6.58	8

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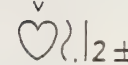
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	BIG	3.15	3.83	.00	4.56	6.80		100
	BIRD	4.63	5.65	6.96	6.67	6.49	7.88	100
	BITTER	2.00	2.30	.00	4.19	5.49		50
	BLOOD	2.08	3.93	6.82	6.70	6.34	6.56	100
	BLUE	1.38	2.88	.00	5.88	6.59		100
	BOARD	1.90	4.43	6.87	6.07	6.06	6.92	100
	BODY	1.88	4.98	6.58	6.40	6.72	5.61	100
	BOOK	4.85	5.48	6.96	6.43	6.88	7.68	100
	BOSS	1.73	3.13	6.35	5.73	6.14	5.81	23
	BOTTLE	2.33	5.73	6.94	6.57	6.31	7.24	50
	BOULDER	1.85	3.35	6.96	6.13	4.44	5.88	5
	BOUQUET	3.18	4.78	6.55	6.77	5.19	5.76	8
	BOY	3.90	5.36	6.93	6.57	6.90	6.96	100
	BRAIN	2.30	4.48	6.63	5.93	6.31	6.80	50
	BREAD	3.68	5.53	.00	6.25	6.83	50	0
	BREASTS	3.53	5.35	6.80	6.77	5.91	5.81	50
	BROKEN	3.50	3.28	.00	4.66	6.29		100
	BUILDING	6.35	6.65	6.94	6.40	6.63	5.48	100
	BUTTER	1.53	2.23	6.96	6.57	6.63	6.91	100

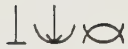
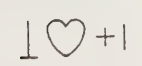
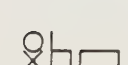
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Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	BUTTERFLY	4.23	4.93	6.93	6.63	4.81	7.80	22
	CABIN	3.98	4.73	6.96	6.47	5.45	7.20	50
	CAMP	3.05	2.95	6.56	6.57	6.25	7.17	100
	CANDY	1.55	1.93	6.56	6.63	6.18	6.39	32
	CANE	2.50	3.63	6.93	6.43	4.82	7.48	19
	CAR	6.10	6.88	7.00	6.87	6.86	6.38	100
	CENTRE	3.50	4.53	.00	4.19	5.94		100
	CHAIR	6.80	6.83	7.00	6.63	6.83	7.20	100
	CHIEF	1.95	3.08	5.87	6.07	4.96	6.08	100
	CHIN	5.48	6.60	6.96	6.43	5.85	5.28	27
	CHORUS	3.03	2.65	.00	5.26	4.48		17
	CHRISTMAS	3.90	3.28	4.53	6.70	6.51	8.76	50
	CHURCH	3.23	5.93	6.59	6.63	5.96	7.52	100
	CIRCLE	3.15	3.13	6.00	6.23	6.08	4.88	100
	CITIZEN	2.45	5.35	.00	4.44	5.94		50
	CITY	4.13	5.20	6.41	6.43	6.63	7.72	100
	CLEAN	1.38	1.78	.00	4.63	6.85		100
	CLIMBED	3.35	3.55	.00	4.03	5.37		0
	CLOCK	5.83	4.98	6.94	6.50	6.48	7.08	50

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	CLOTHING	1.73	4.25	6.63	6.17	6.54	7.08	50
	COFFEE	1.68	3.03	6.89	6.73	6.89	7.28	50
	COIN	2.48	3.68	6.90	6.50	5.90	7.09	50
	COLD	1.55	2.45	.00	4.78	6.81		100
	COME	4.20	4.93	.00	2.56	6.71		100
	COMMAND	5.40	6.05	.00	2.97	5.73		100
	COMPETITION	4.00	5.13	3.08	4.53	5.90	5.69	28
	CONTRIBUTION	1.93	4.43	3.33	3.67	5.45	5.44	19
	CORD	2.15	2.93	6.93	6.03	4.82	6.00	30
	CORPSE	2.55	3.35	6.89	6.50	4.46	6.52	9
	COST	1.65	2.80	3.41	3.57	6.54	6.24	100
	COTTAGE	3.85	5.13	6.90	6.50	6.40	7.76	46
	COUNTRY	4.70	6.18	.00	5.47	6.38		100
	CRADLE	3.93	4.28	6.94	6.23	5.00	6.96	21
	CREATOR	1.83	6.05	3.97	3.87	4.71	5.68	8
	CREATURE	1.55	3.43	6.03	4.60	5.31	5.50	50
	CURRENT	1.83	4.10	.00	5.00	5.49		50
	DARK	1.73	4.35	.00	5.63	6.57		100
	DEATH	2.58	3.98	2.97	5.00	6.43	7.12	100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	DEED	1.55	6.30	4.19	3.63	5.15	5.32	50
	DEEP	4.50	3.58	.00	4.69	5.71		100
	DESCRIBE	1.55	3.55	2.66	2.66	6.50	50	50
	DESCRIPTION	1.70	5.33	.00	2.69	6.14		30
	DESTROYED	1.28	3.85	.00	3.75	5.98		0
	DEVELOPMENT	2.03	4.13	2.82	3.07	5.76	6.04	50
	DIFFERENT	2.18	4.58	.00	2.84	5.98		100
	DINNER	1.68	3.30	.00	5.93	6.74		100
	DIRECTION	3.83	4.60	3.19	3.83	5.94	6.78	100
	DIRTY	1.43	2.30	.00	4.84	6.29		31
	DO	1.75	4.98	.00	1.41	6.73		100
	DOCTOR	3.83	3.43	6.62	6.40	6.00	7.32	100
	DOLL	2.55	4.80	6.94	6.17	5.73	6.12	46
	DOLLAR	6.80	6.80	6.62	6.50	6.73	6.48	100
	DOOR	4.40	5.45	7.00	6.60	6.60	7.96	100
	DRAW	1.73	2.60	.00	4.19	5.73		100
	DREAM	1.83	3.78	3.03	4.60	5.94	5.44	100
	DREAMER	1.50	2.98	5.10	5.33	5.65	5.04	4
	DRESS	2.35	3.63	6.93	6.53	6.35	5.68	100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	DRINK	2.18	4.15	.00	5.22	6.87		100
	DRY	1.88	2.60	.00	4.13	6.55		100
	DUST	3.98	5.25	6.67	6.03	6.04	6.84	50
	EARTH	3.93	4.55	6.58	6.27	6.47	7.56	100
	EASY	1.73	2.55	.00	2.53	6.75		100
	ELBOW	3.70	3.33	6.94	6.30	5.94	5.16	26
	EMPTY	2.25	3.73	.00	4.38	6.26		50
	ENGAGEMENT	2.83	3.60	3.46	4.70	5.75	5.76	24
	ENVOIOUS	1.53	2.23	.00	3.25	5.10		6
	EQUAL	6.48	5.05	.00	2.74	6.31		50
	EVENT	1.48	3.73	3.72	2.90	6.14	5.04	50
	EXCUSE	1.33	3.05	3.05	2.77	6.27	4.04	50
	FACT	1.83	4.68	3.31	2.20	6.49	4.29	100
	FACTORIES	3.30	5.28	6.87	6.43	6.02	6.00	50
	FAMILY	4.08	4.83	.00	5.81	6.42		100
	FAST	3.10	2.93	.00	3.91	6.55		100
	FEW	1.60	2.38	2.69	2.69	6.72	100	100
	FIRE	3.55	5.83	6.66	6.70	6.40	7.36	100
	FIREPLACE	4.35	5.20	6.96	6.83	5.69	7.08	19

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
v								
l.	FIRST	5.53	3.75	.00	2.94	6.69		100
	FISHERMAN	2.88	2.88	6.52	6.50	5.17	7.84	26
	FLAG	6.15	6.18	6.94	6.60	6.10	6.54	50
	FLOWER	4.35	6.25	6.96	6.57	5.96	7.13	100
	FOOT	3.38	4.58	.00	6.31	6.45		100
>>	FOR	1.65	5.88	.00	1.41	6.86		100
	FOREST	4.23	3.70	6.69	6.63	5.58	9.12	100
	FORK	6.30	6.65	6.94	6.57	6.04	7.08	31
	FORM	1.83	3.05	4.08	4.30	5.92	4.60	100
	FREE	1.80	4.85	.00	3.69	6.73		100
	FREEDOM	2.48	5.65	1.98	3.83	6.31	6.36	50
	FRESH	1.70	2.38	.00	4.44	6.16		100
	FRIEND	3.08	3.28	4.89	6.37	6.70	6.40	100
	FRIGHTENED	2.28	2.93	.00	4.38	6.11		0
l>	FROM	2.23	4.20	.00	1.72	6.85		100
	FRONT	3.55	4.38	.00	4.00	6.35		100
	FRUIT	5.30	6.43	.00	5.53	6.19		100
	FULL	2.40	4.75	.00	4.41	6.39		100
	FURNITURE	4.93	5.78	6.83	6.17	6.20	6.60	50

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	GALLERY	1.75	3.35	6.49	5.97	4.94	5.88	28
	GARDEN	3.08	5.58	6.83	6.73	5.43	6.36	100
	GET	1.73	4.18	.00	1.66	6.67		100
	GIFT	1.78	4.33	5.95	5.77	6.00	7.04	50
	GIRL	4.90	6.18	6.83	6.87	6.92	5.12	100
	GIVE	2.45	4.75	.00	3.38	6.64		100
	GOLF	3.83	3.40	6.10	6.70	5.71	8.16	26
	GRANDMOTHER	2.25	6.00	6.66	6.43	5.85	6.08	48
	GRASS	2.20	3.53	6.96	6.63	6.30	7.54	100
	GRAVITY	4.68	5.45	2.56	3.60	5.33	6.24	14
	GREEN	1.43	3.15	5.46	6.60	6.55	6.68	100
	GRIEF	3.63	3.00	1.86	4.70	5.49	6.32	45
	GUN	3.43	6.20	.00	6.13	6.11		50
	HAMMER	4.75	5.63	6.96	6.73	5.47	6.92	34
	HAND	1.83	4.05	.00	6.00	6.57		100
	HAPPINESS	4.68	4.05	1.94	5.13	6.17	6.00	50
	HAPPY	4.58	3.88	.00	4.72	6.71		100
	HATRED	2.48	4.60	1.59	3.97	5.84	4.84	20
	HAVE	1.53	3.53	.00	1.61	6.88		100

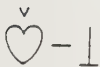
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Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
①	HEAD	2.75	4.33	.00	5.69	6.62		100
4	HEALTH	1.88	6.38	3.54	4.10	6.33	6.39	100
↺	HEARING	5.13	4.95	3.57	3.77	6.16	6.64	13
△↓	HEAVY	3.55	4.00	.00	4.91	6.41		100
>..	HERE	2.55	4.10	.00	1.88	6.69		100
∨ —	HIGH	3.23	3.13	.00	4.16	6.74		100
🏠❤	HOME	4.88	5.33	6.25	6.50	6.65	6.88	100
❤↑👂	HOPE	3.58	3.65	1.18	3.83	6.02	5.52	100
🏠👨	HOSPITAL	2.90	4.98	6.80	6.53	6.06	7.44	50
↺>	HOT	2.38	3.35	.00	5.59	6.61		100
🏠⊥🏠	HOTEL	2.63	4.60	6.80	6.40	5.92	5.96	50
🕒°	HOUR	4.33	5.15	2.93	3.60	6.73	5.56	100
🏠	HOUSE	6.78	6.60	6.93	6.67	6.79	6.83	100
?^	HOW	2.80	3.53	.00	1.50	6.65		100
❤↑○	HUMOROUS	2.48	3.05	.00	4.28	5.90		8
❤↑○	HUMOUR	2.53	3.28	2.31	4.57	6.00	5.72	41
❤—○	HUNGRY	1.85	3.00	.00	5.06	6.45		50
❤^	HURT	2.20	2.83	.00	4.28	5.98		100
^	HUSBAND	2.03	4.33	.00	5.59	6.15		100

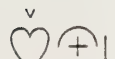
APPENDIX A

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	I	2.25	2.73	.00	3.97	6.88		100
	IDEA	1.85	4.38	1.42	2.20	6.50	4.88	100
	IF	2.68	3.23	.00	1.38	6.85		100
	IMPORTANT	2.68	4.10	.00	3.00	6.64		100
	IMPROVE	1.50	2.18	.00	2.56	6.18		50
	IN	4.58	5.08	.00	2.50	6.94		100
	INCORRECT	1.75	2.85	.00	3.19	6.04		3
	INFANT	3.73	5.33	6.76	6.33	5.53	7.20	22
	INSTRUMENT	1.50	2.53	6.25	5.67	5.94	6.72	42
	INTELLECT	2.30	3.78	1.83	2.93	5.47	5.56	8
	INTEREST	2.50	3.85	2.20	3.13	6.24	5.52	100
	INTO	5.60	4.80	.00	1.84	6.64		100
	IRON	5.98	6.00	6.87	6.07	6.11	6.12	100
	ISLANDER	2.45	3.33	6.28	5.43	4.23	5.48	1
	IT	1.65	4.95	.00	1.63	6.94		100
	JAIL	4.60	4.65	6.69	6.43	5.46	7.38	22
	JEALOUSY	1.88	2.63	.00	4.34	5.59		25
	JELLY	2.80	4.65	6.73	6.40	5.48	6.00	19
	JOKE	2.13	2.80	3.80	4.27	6.51	5.92	32

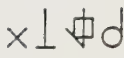
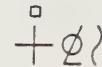
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	KIND	2.18	2.75	.00	3.56	6.37		100
	KING	4.43	6.20	6.34	6.27	5.58	7.50	100
	KISS	3.00	5.30	6.13	6.80	6.34	6.68	100
	KNOW	2.08	5.68	.00	1.84	6.48		100
	KNOWLEDGE	1.90	6.38	1.56	2.97	6.29	6.36	100
	LAKE	3.45	3.98	6.90	6.67	6.37	9.22	100
	LAMP	2.673	3.70	.00	6.22	6.36		50
	LARGE	3.08	3.78	.00	4.38	6.74		100
	LAST	1.58	2.35	.00	2.72	6.49		100
	LATE	2.90	3.45	.00	3.53	6.72		100
	LEADER	2.33	2.80	5.83	5.13	5.98	6.16	100
	LEFT	2.93	3.68	.00	3.78	6.65		100
	LEND	1.40	3.38	.00	2.81	6.06		35
	LETTER	6.90	6.78	6.94	6.37	6.57	5.96	100
	LIBRARY	4.13	5.15	6.87	6.73	6.43	6.40	50
	LIFE	2.25	5.78	2.96	4.07	6.57	6.78	100
	LIFT	2.95	3.70	.00	4.28	5.86		100
	LIGHT	3.20	6.35	.00	5.72	6.22		100
	LIKE	1.88	3.15	.00	2.72	6.82		100

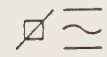
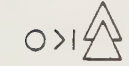
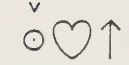
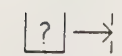
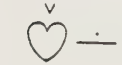
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	LIP	2.25	3.93	6.93	6.57	6.08	6.80	38
								
	LITTLE	3.05	4.33	.00	4.34	6.56		100
	LIVE	1.75	3.78	.00	4.13	6.71		100
	LONELY	2.98	2.95	.00	4.31	6.21		35
	LOOK	3.35	3.65	.00	3.00	6.71		100
	LORD	1.98	6.33	4.18	4.63	5.50	6.68	100
	LOVE	5.30	6.20	1.80	5.60	6.67	6.44	100
								
	LOW	2.20	3.33	.00	3.59	6.20		100
	LUMBER	2.93	3.20	.00	5.78	5.47		34
	MACHINE	2.15	4.75	6.75	6.00	5.89	5.88	100
	MAD	2.05	2.73	.00	4.59	6.35		50
	MAGAZINE	2.18	4.25	6.80	6.40	6.41	6.52	50
								
	MAKE	1.58	4.05	.00	2.53	6.82		100
	MAN	4.60	5.10	.00	6.16	6.85		100
	MANY	2.85	5.95	.00	3.09	6.58		100
	MATERIAL	1.83	4.20	6.10	5.07	5.94	5.92	100
	MATHEMATICS	1.88	4.50	4.35	4.50	6.15	6.88	8
	MAYBE	3.03	3.93	.00	1.47	6.38		50
	ME	2.28	3.28	.00	3.06	6.67		100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	MEAT	1.98	3.80	6.93	6.63	6.51	8.32	100
	MEETING	5.25	5.75	4.80	5.20	5.96	5.00	100
	METAL	1.50	3.65	6.76	5.87	5.80	6.96	50
	METHOD	1.60	4.85	2.20	2.63	6.04	5.20	100
	MIND	2.70	5.73	2.60	3.03	6.51	5.88	100
	MISS	3.15	3.48	.00	4.13	6.49		100
	MISTAKE	1.38	2.48	.00	3.50	6.24		50
	MONEY	2.60	5.40	6.63	6.43	6.84	6.68	100
	MONTH	2.23	6.23	3.20	4.37	6.38	4.58	100
	MOON	7.00	6.90	.00	6.22	6.57		100
	MOTHER	3.13	6.13	6.52	6.67	6.86	5.83	100
	MOVE	1.90	4.08	.00	3.19	6.45		100
	MULE	1.75	3.48	6.96	6.60	4.84	6.12	29
	MULTIPLICATION	6.60	6.20	3.84	4.73	6.08	6.00	5
	MUSICIAN	3.93	3.65	6.53	6.13	5.98	6.52	18
	MUST	1.30	3.03	4.33	.00	1.47	6.59	100
	MY	1.58	2.25	.00	1.94	6.87		100
	NAIL	4.95	5.86	6.96	6.50	6.12	6.08	50
	NARROW	2.43	2.70	.00	4.69	5.94		100

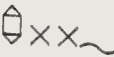
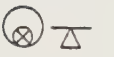
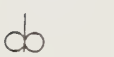
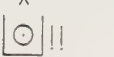
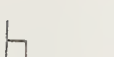
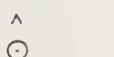
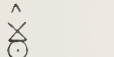
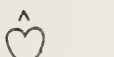
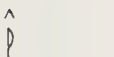
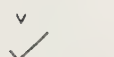
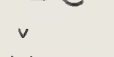
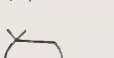
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
	NATURE	2.00	6.35	.00	5.09	5.39		100
	NEAR	2.18	4.18	.00	3.41	6.39		100
	NECESSITY	1.48	4.18	1.97	3.00	5.81	5.92	50
	NEPHEW	1.83	3.68	6.19	4.30	4.92	4.48	22
	NEW	1.85	3.45	.00	3.50	6.83		100
	NICE	2.55	2.83	.00	2.78	6.48		100
	NOISY	2.85	3.78	.00	1.38	6.49		14
	NONSENSE	2.23	4.65	1.90	3.07	5.14	4.12	19
	OBEDIENCE	1.60	2.48	1.58	3.67	5.40	5.20	15
	OBEY	1.50	2.45	.00	3.13	5.78		50
	OCEAN	4.05	3.48	6.90	6.77	5.63	8.76	100
	ODOUR	4.00	5.15	5.83	5.13	5.36	5.76	27
	OF	1.68	5.00	.00	1.19	6.98		100
	OFF	2.23	3.23	.00	2.44	6.71		100
	OFFICER	1.55	3.70	6.32	6.23	5.89	5.43	100
	OLD	1.45	2.35	.00	4.50	6.74		100
	ON	4.28	4.00	.00	2.13	6.86		100
	ONLY	1.98	3.60	.00	1.66	6.75		100
	OPEN	4.13	4.48	.00	3.84	6.12		100

APPENDIX A

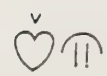
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	OPINION	1.98	5.43	2.29	3.23	5.90	4.96	100
	OR	1.55	4.63	.00	1.25	6.71		100
	ORCHESTRA	3.10	2.38	6.55	6.77	5.82	6.76	10
	OUR	1.63	2.30	.00	2.66	6.86		100
	OUT	5.08	4.45	.00	2.69	6.77		100
	OUTSIDE	5.73	4.35	.00	4.00	6.47		100
	OUTSIDER	1.45	2.05	5.07	5.27	5.08	4.56	3
	OVEN	2.55	4.73	6.96	6.40	6.31	8.08	29
	OVER	5.13	4.35	.00	2.16	6.38		100
	OWNER	1.60	3.50	5.90	4.23	6.15	5.71	50
	PAINT	1.45	3.08	.00	5.88	5.88		100
	PAINTER	1.48	2.78	6.59	5.87	6.15	6.40	25
	PAPER	4.45	5.90	6.89	6.30	6.79	7.68	100
	PARTY	3.05	3.70	5.50	6.27	6.59	7.08	100
	PASSION	3.95	3.45	1.66	5.30	5.46	5.68	50
	PENCIL	3.35	4.83	7.00	6.37	6.35	6.48	40
	PEPPER	1.68	2.00	6.96	6.27	6.08	6.52	27
	PERHAPS	3.00	4.00	.00	1.44	6.30		100
	PERIOD	6.65	5.83	.00	4.00	6.22		100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	PERSON	3.30	4.90	6.51	5.83	6.60	5.68	100
	PHYSICIAN	3.70	3.35	6.59	6.37	5.79	5.92	43
	PICTURE	2.30	3.35	6.75	6.20	6.24	7.16	100
	PIPE	4.93	6.30	6.90	6.43	5.78	6.20	50
	PLAN	1.68	4.88	.00	3.44	6.08		100
	PLANT	5.20	5.80	6.87	6.50	6.31	8.32	100
	POETRY	3.15	6.08	4.27	4.90	5.77	6.24	26
	POISON	1.78	3.30	.00	5.25	5.55		42
	POLICEMAN	1.60	3.48	6.69	6.70	6.10	6.96	22
	POLLUTION	2.18	3.00	4.14	4.63	5.94	7.40	3
	POOR	2.35	3.38	.00	4.56	5.90		100
	POWER	3.15	4.83	2.73	4.47	5.77	5.88	100
	PRAYER	2.23	3.75	3.60	5.17	5.36	6.63	50
	PRESENT	1.55	5.33	3.88	4.80	6.09	6.13	100
	PRETTY	2.60	3.00	.00	4.81	6.57		100
	PRIEST	1.80	3.50	6.59	6.53	5.29	6.88	42
	PRISON	4.83	4.90	6.62	6.23	5.02	7.21	50
	PROBLEM	3.20	3.98	.00	3.72	6.38		100
	PROUD	2.10	2.75	.00	4.31	6.16		50

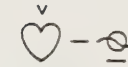
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thom- dike- Lorge Frequency
	PUPIL	1.73	3.48	6.63	6.37	6.00	6.24	50
	QUEEN	3.65	5.08	6.38	6.57	5.88	7.36	100
	QUICK	2.90	2.95	.00	3.34	6.24		50
	QUIET	2.33	4.08	.00	3.75	6.45		50
	REAL	1.55	3.78	.00	3.47	6.48		100
	REASON	1.98	4.50	.00	1.78	6.66		100
	REFRIGERATOR	3.23	3.50	7.00	6.67	5.88	7.36	11
	REPORT	1.98	4.35	.00	3.59	6.34		100
	REST	2.18	3.83	.00	3.56	6.41		100
	RESTAURANT	2.03	3.00	6.83	6.47	6.33	6.88	23
	RETURN	4.25	4.78	.00	2.38	6.22		100
	RICH	1.90	2.90	.00	4.53	6.40		100
	RIDE	3.45	3.90	.00	4.91	6.39		100
	RIVER	4.50	4.18	6.83	6.63	6.06	7.52	100
	ROCK	2.18	4.93	6.96	6.37	6.34	5.96	100
	ROOM	3.53	4.43	.00	5.56	6.76		100
	SAD	3.88	3.80	.00	4.19	6.47		50
	SADNESS	4.18	3.85	2.47	4.63	5.84	5.56	11
	SAFETY	2.33	4.00	2.25	4.27	6.10	5.76	50

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	SALAD	2.90	4.98	6.83	6.53	6.16	7.20	28
	SALT	1.80	2.97	.00	5.56	6.58		100
	SCALES	4.08	4.80	.00	5.25	5.27		0
	SCIENCE	2.33	5.33	3.05	4.07	6.22	6.56	50
	SCISSORS	4.30	5.50	.00	6.19	5.96		8
	SEA	3.10	3.35	6.79	6.73	5.63	7.16	100
	SEARCH	2.23	4.73	.00	3.47	5.73		50
	SEAT	6.65	6.55	6.79	6.40	6.49	6.08	100
	SEE	3.13	3.98	.00	3.16	6.80		100
	SELECT	1.48	3.45	.00	2.59	5.83		50
	SELL	2.05	2.85	.00	3.53	6.31		100
	SENSATION	2.63	4.73	1.99	3.67	5.43	5.16	20
	SEW	2.73	4.18	.00	4.75	5.57		34
	SHAME	2.08	2.55	1.70	4.10	5.71	5.16	50
	SHARP	2.08	4.50	.00	4.97	6.12		50
	SHIP	4.63	6.10	6.93	6.67	5.84	7.87	100
	SHORE	4.05	4.08	6.69	6.63	5.71	8.13	100
	SHORT	3.13	4.25	.00	3.94	6.51		100
	SHOULDER	1.98	5.45	.00	5.94	6.09		100

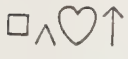
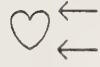
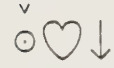
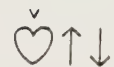
APPENDIX A

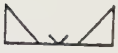
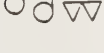
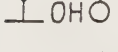
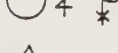
Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	SHOUT	3.23	3.53	.00	4.63	6.38		100
-2	SILENCE	2.50	5.93	3.09	4.10	6.18	5.82	100
=	SIMILAR	2.65	3.93	.00	2.78	5.94		50
l o d	SINGER	3.23	4.20	6.35	6.17	6.00	6.64	20
	SIT	4.90	4.58	.00	4.56	6.49		100
	SKIN	1.40	3.25	6.96	6.43	6.43	5.67	100
—	SKY	2.85	5.13	6.18	6.73	6.45	7.84	100
	SLEEP	1.83	4.55	.00	5.34	6.80		100
	SMALL	3.23	3.60	.00	3.88	6.66		100
	SMART	2.55	3.53	.00	3.63	6.59		50
	SMOOTH	1.53	2.50	.00	4.44	6.33		50
	SNAKE	5.20	5.15	7.00	6.90	5.69	6.88	28
	SNOW	3.75	3.65	.00	6.34	6.85		100
	SOFT	2.05	2.88	.00	4.81	6.33		100
	SOLDIER	2.20	4.53	.00	5.59	5.45		100
	SON	2.58	4.88	.00	5.81	6.47		100
	SOUR	1.73	2.48	.00	4.66	5.69		15
	SPEAKER	1.95	3.98	6.13	5.67	5.94	5.54	25
	SPECIAL	3.03	2.88	.00	2.53	6.47		100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	SPEECH	1.80	4.13	4.87	4.33	6.04	5.36	100
	SPIDER	3.38	3.53	.00	6.27	5.30		24
	SQUARE	3.20	3.15	5.70	6.37	6.27	5.44	100
	STAND	2.90	3.65	.00	4.16	6.50		100
	STAR	6.08	6.08	6.73	6.70	6.09	7.04	100
	STEAM	3.70	4.38	6.41	6.37	5.65	7.46	50
	STEM	3.08	5.53	.00	5.28	5.35		39
	STOMACH	2.18	4.60	.00	5.34	6.00		30
	STONE	2.03	5.05	6.96	6.23	6.26	7.24	100
	STOREROOM	1.93	3.00	6.73	5.87	4.96	6.52	2
	STORM	2.60	2.75	6.45	6.43	5.83	7.21	100
	STORY	1.73	4.53	.00	4.66	6.55		100
	STOVE	2.48	4.78	.00	6.25	6.08		40
	STRENGTH	2.65	4.23	2.90	4.36	6.16	5.12	100
	STRING	1.50	3.13	6.90	6.20	6.11	5.29	50
	STRONG	2.60	4.35	.00	4.56	6.43		100
	STUDENT	1.63	3.63	6.38	6.27	6.83	5.96	50
	SUBTRACTION	5.90	5.35	3.73	3.80	5.55	5.52	1
	SUGAR	1.58	2.28	6.96	6.57	6.74	7.00	100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	SUNSET	5.30	4.43	6.07	6.83	5.66	6.96	24
	SUPERIOR	3.55	3.95	.00	3.47	5.74		50
	SUPPORT	3.23	3.78	.00	3.22	5.96		100
	SWEET	2.35	2.43	.00	4.72	6.38		100
	TABLE	5.98	5.53	7.00	6.50	6.76	7.60	100
	TAKE	1.63	4.00	.00	2.53	5.98		100
	TALE	1.43	4.33	.00	3.50	5.33		50
	TALK	2.20	4.60	.00	3.72	6.65		100
	TASTE	1.53	3.33	.00	3.78	6.52		100
	TEACHER	2.00	3.80	6.38	5.77	6.38	6.00	100
	TELL	2.28	4.98	.00	2.59	6.56		100
	TEMPLE	3.80	6.08	6.69	6.13	4.80	6.75	50
	THAT	2.15	4.83	.00	1.25	6.96		100
	THE	1.70	4.48	.00	1.50	6.98		100
	THEN	1.55	4.60	.00	1.38	6.80		100
	THIN	4.45	4.58	.00	4.72	6.28		100
	THINK	2.58	4.98	.00	2.59	6.69		100
	THIRSTY	2.13	2.80	.00	4.59	6.55		11
	THIS	2.13	4.00	.00	1.72	6.90		100

APPENDIX A

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	THOUGHT	2.18	4.80	1.28	2.77	6.35	5.32	100
	TICKET	2.60	4.55	7.00	6.20	6.29	7.21	50
	TIME	5.83	6.33	2.47	4.13	6.82	7.00	100
	TIRED	1.80	3.05	.00	4.00	6.70		100
>	TO	3.15	4.05	.00	1.44	6.82		100
	TOBACCO	3.25	4.25	6.87	6.27	6.31	7.84	36
	TOOL	1.65	2.60	6.80	5.77	5.94	6.88	40
	TOP	4.38	6.08	.00	4.44	6.50		100
	TOY	2.00	2.40	6.63	6.17	6.18	6.96	49
	TRADE	1.65	4.35	.00	3.63	5.77		100
	TREE	5.85	6.28	7.00	6.77	6.88	6.79	100
	TROUBLE	2.13	3.68	2.25	3.53	6.29	5.08	100
	TRUCK	6.38	6.80	7.00	6.60	6.60	6.48	23
	TRUTH	2.03	4.18	1.69	2.73	6.45	4.78	100
	UGLY	2.10	2.98	.00	5.06	6.21		34
	UMBRELLA	5.93	6.35	7.00	6.60	5.78	6.76	13
	UP	6.78	6.28	.00	3.66	6.82		100
	UPSET	2.78	3.75	.00	4.16	5.74		20
	US	2.03	2.85	.00	3.88	6.75		100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Lorge Frequency
	UTENSIL	1.63	2.30	6.58	5.47	5.34	6.08	8
	VACUUM	1.73	3.55	3.87	4.77	5.27	5.94	5
	VALLEY	4.55	4.63	6.66	6.57	5.43	6.56	100
	VEGETABLE	3.68	5.73	6.76	5.83	6.44	6.92	50
	VEHICLE	5.33	4.63	6.45	6.23	5.74	7.08	13
	WATER	5.48	6.03	6.96	6.60	6.90	7.50	100
	WE	1.93	2.88	.00	3.63	6.82		100
	WEATHER	2.50	3.75	.00	5.34	6.29		100
	WET	3.03	4.35	.00	5.31	6.52		50
	WHAT	6.03	6.15	.00	1.47	6.80		100
	WHERE	4.35	4.08	.00	1.69	6.86		100
	WHISTLE	2.78	2.93	.00	5.81	5.02		50
	WHO	3.65	3.68	.00	1.69	6.80		100
	WIDE	4.15	4.25	.00	4.16	6.22		100
	WIFE	1.93	3.68	6.52	6.53	6.41	6.48	100
	WINDOW	6.58	6.33	7.00	6.37	6.59	6.76	100
	WINE	3.65	4.00	6.96	6.60	6.36	7.54	50
	WINTER	2.80	2.05	5.83	6.53	6.74	8.32	100
	WISH	1.60	4.65	.00	3.44	6.14		100

Symbol	Concept	$\bar{X}$ R sym	$\bar{X}$ I sym	$\bar{X}$ C word	$\bar{X}$ I word	Print fam	Mean- ingful- ness	Thorn- dike- Large Frequency
?▷	WHY	3.83	4.03	.00	1.69	6.71		100
++	WITH	3.73	5.75	.00	2.22	6.80		100
△	WOMAN	3.95	5.08	6.63	6.70	6.80	6.40	100
××↑	WOODS	5.10	4.08	6.87	6.70	6.04	7.84	0
△^	WORKHOUSE	2.98	5.65	6.31	4.00	3.35	4.88	1
— —	WORLD	21.53	5.18	5.90	5.97	6.70	6.88	100
∩ ₁	WRONG	1.68	2.98	.00	2.94	6.50		100
⊥ ₂	YOU	2.08	3.55	.00	3.31	6.96		100
∩ ₁	YOUNG	2.90	5.03	.00	5.31	6.49		100

APPENDIX B

Instructions to subjects and example pages for the representativeness and imagery rating studies of Blissymbols. 1. Representativeness Instructions.

The purpose of this study is to have you make a judgment as to the degree of relationship between a symbol and a corresponding word. Any symbol which, in your estimation is a highly appropriate representation of the corresponding word, should be given a "highly representative" rating. Any symbol which does not, in your estimation represent the meaning of the word should be given a "poorly representative" rating.

Take for example the following symbols:

 -Question

poorly 1 2 3 4 5 6 highly 7

 -TEETH

Question, by convention and teeth by its pictorial nature, would probably be rated on the "highly representative" end of the scale. On the other hand;

 -TREAT

poorly 1 2 3 4 5 6 highly 7

 -VISITOR

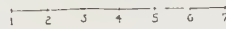
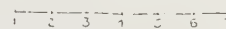
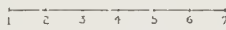
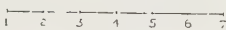
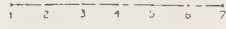
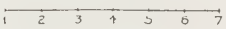
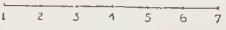
Treat and visitor would probably be rated on the "poorly representative" end of the scale

Some symbols tend to make you think of other words as associates. For example, the symbol for "without" is  which may arouse the associated mathematical symbol for "minus". Therefore, it is important that you rate only the representativeness of the word given.

Your ratings will be made on a seven point scale (as shown above), where 1 is poorly representative and 7 is highly representative. Rate the symbol by putting a circle around any number from 1 to 7 that best indicates your judgment of the representativeness of the symbol to the word. Symbols that are intermediate in representativeness should be rated between the two extremes. Feel free to use the entire range of numbers. At the same time don't be concerned about how often you use a particular number as long as it is your true judgment. Work fairly quickly but do not be careless in your ratings. If necessary, refer back to these instructions when rating the symbols.

APPENDIX B

Sample of the last page for the representativeness ratings.

 TEACHER  TAKE  SAD  NOISY	   	 SHARP  IMPORTANT  HUSBAND  BREAD	   
 COUNTRY  TELL  SIXTY  COLD	   	 REAL  TROUBLE  HEAVY	  
AGE: YEAR:	SEX: MAJOR:	 SELL	

APPENDIX B

2. Imagery Instructions.

Symbols differ in their capacity to arouse mental images of things or events. Some symbols arouse a sensory experience, such as a mental picture or sound, very quickly or easily, whereas others may do so with difficulty (i.e., after a long delay) or not at all. The purpose of this study is to rate a list of symbols as to the ease or difficulty with which they arouse mental images. Any symbol which, in your estimation, arouses a mental image (i.e., a mental picture, sound or other sensory experience) very quickly and easily should be given a high imagery rating; any symbol given a low imagery rating: for instance these two symbols [S] and [Ψ]. The first may have elicited an image of a snake, a piece of string or a road sign for an "S" curve. The second may have elicited an image of the devil's or Neptune's fork or simply a "pitch-fork". The second symbol however, is the Greek letter for psi which is also used to represent psychology. To some each symbol would probably arouse an image relatively easily and would be rated as high; whereas to others one or both symbols may have elicited images more slowly or not at all and therefore be rated low. Since symbols may tend to make you think of other symbols as associates (as do knife-fork and table-chair) it is important that you note only the ease of getting a mental image of an object or event to the symbol.

Your ratings will be made on a seven point scale where one (1) is the low imagery value and seven (7) is the high end of the imagery scale. Circle the number from 1 to 7 that best indicates your judgment of the ease or difficulty with which the symbol arouses mental images for you. Symbols that are intermediate in ease or difficulty in arousing images should be rated appropriately between the two extremes. Feel free to use the entire range of numbers from 1 to 7 and don't be concerned about how often you use a particular number as long as it is your true judgment. Work quickly but do not be careless in your ratings. Please do not look back once you have rated a symbol.

Below are 4 examples to try. Indicate the ease of getting an image by circling the appropriate number.

If necessary refer back to these instruction when rating the symbols. Do you have any questions?

¢ 1—2—3—4—5—6—7

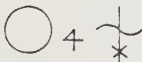
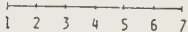
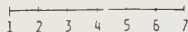
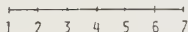
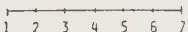
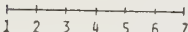
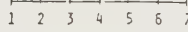
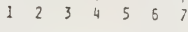
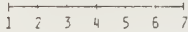
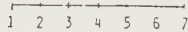
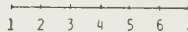
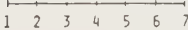
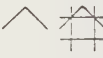
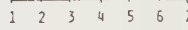
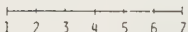
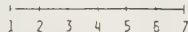
↓ 1—2—3—4—5—6—7

⌞ 1—2—3—4—5—6—7

× ⊕ ∇ □ 1—2—3—4—5—6—7

APPENDIX B

Sample of last page from the imagery rating study.

AGE:

SEX:

YEAR:

MAJOR:

APPENDIX C

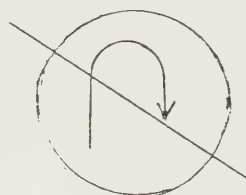
Representativeness and imagery values for word pairs (synonyms) used for within subject reliability (Yovetich & Paivio, 1982).

CONCEPTS		R VALUES		I VALUES	
1.	Like	Similar	1.88 2.65	3.15	3.93
2.	Afraid	Frightened	1.98 2.28	2.98	2.93
3.	Air	Atmosphere	1.58 1.55	4.68	3.75
4.	Alone	Only	2.13 1.98	2.65	3.60
5.	Anger	Mad	2.10 2.05	2.68	2.73
6.	Car	Automobile	6.10 6.03	6.88	6.85
7.	Baby	Infant	3.65 3.73	5.28	5.33
8.	Storeroom	Storeroom	1.93 2.03	3.00	3.00
9.	Incorrect	Wrong	1.75 1.68	2.85	2.98
10.	Big	Large	3.15 3.08	3.83	3.78
11.	Building	House	6.35 6.78	6.65	6.60
12.	Cabin	Cottage	3.98 3.85	4.73	5.13
13.	Happy	Happiness	4.58 4.68	3.88	4.05
14.	Chair	Seat	6.80 6.65	6.83	6.55
15.	Church	Temple	3.23 3.80	5.93	6.08
16.	Sad	Sadness	3.88 4.18	3.80	3.85
17.	Doctor	Physician	3.83 3.70	3.43	3.35
18.	Fast	Quick	3.10 2.90	2.93	2.95
19.	Little	Small	3.05 3.23	4.33	3.60
20.	Forest	Woods	4.23 5.10	3.70	4.08
21.	Creator	Lord	1.83 1.98	6.05	6.33
22.	Humorous	Humor	2.48 2.53	3.05	3.28
23.	Instrument	Tool	1.50 1.65	2.53	2.60
24.	Intellect	Smart	2.30 2.55	3.78	3.53
25.	Jail	Prison	4.60 4.83	4.65	4.90
26.	Look	See	3.35 3.13	3.65	3.98
27.	Ocean	Sea	4.05 3.10	3.48	3.35
28.	Leader	Chief	2.33 1.95	2.80	3.08
29.	Maybe	Perhaps	3.03 3.00	3.93	4.00
30.	Me	I	2.28 2.75	3.28	2.73
31.	Method	Plan	1.60 1.68	4.85	4.88
32.	Pupil	student	1.73 1.63	3.48	3.63
33.	Out	Outside	5.08 5.73	4.45	4.35
34.	Oven	Stove	2.55 2.48	4.73	4.78
35.	Officer	Policeman	1.55 1.60	3.70	3.48
36.	Story	Tale	1.73 1.43	4.53	4.33
37.	Rock	Stone	2.18 2.03	4.93	5.05
38.	Tell	Talk	2.28 2.20	4.98	4.60
39.	Think	Reason	2.58 1.98	4.98	4.50
40.	We	Us	1.93 2.03	2.88	2.85
		r= .97		r= .93	

APPENDIX D

Instructions to subjects in the Yovetich and Young (1983) transparency study

We encounter a variety of signs and symbols in everyday living. They serve to enhance the general concept portrayed by overcoming any problems that language differences may impose on a printed display. Common examples include road signs such as these:



Other familiar signs are, these found on washroom doors:



and mathematical symbols, such as these:



Some symbols are more pictographic, as illustrated by the first four examples. While others, like the mathematical signs, may be derived more arbitrarily and therefore seem less concrete in representation.

The aim of this study is to investigate if various signs and symbols have intuitive representations for people. On the following pages you will be presented with a variety of symbols. Your task is to record in writing what each one represents to you. There are no right or wrong answers. The interpretation is unique to yourself. Please do not verbalize or discuss your ideas and be sure to respond to every symbol.

Do you have any questions?

APPENDIX D

Example of stimulus materials used in the transparency study.



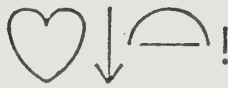
1 _____



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APPENDIX D

The 129 items used in the Yovetich and Lobb (1981) intergroup reliability study.

No.	Noun- Concept (symbol)	Mean R Value	Mean Concrete Value	Mean Imagery Value
1	Ability	1.84	2.03	2.67
2	Affection	5.65	2.18	4.87
3	Afterlife	3.33	1.77	2.40
4	Agreement	4.58	2.93	3.33
5	Anger	3.40	1.70	4.87
6	Apple	5.35	7.00	6.73
7	Arm	3.33	6.96	6.53
8	Arrow	6.51	7.00	6.57
9	Artist	2.81	6.14	5.93
10	Banker	3.12	6.38	6.03
11	Bar	3.04	6.83	6.40
12	Belief	4.42	1.55	2.73
13	Beverage	2.51	5.96	5.87
14	Bird	5.26	6.96	6.67
15	Blood	2.47	6.82	6.70
16	Boss	3.14	6.35	5.73
17	Boulder	2.23	6.96	6.13
18	Bouquet	2.51	6.55	6.77
19	Boy	4.74	6.93	6.57
20	Chair	6.91	7.00	6.63
21	Cabin	4.35	6.96	6.47
22	Chief	2.93	5.87	6.07
23	Chin	5.95	6.96	6.43
24	Circle	3.72	6.00	6.23
25	Clock	6.54	6.94	6.50
26	Coin	3.30	6.90	6.50
27	Competition	5.14	3.08	4.53
28	Contribution	2.67	3.33	3.67
29	Corpse	3.44	6.89	6.50
30	Cradle	4.14	6.94	6.23
31	Creator	3.40	3.97	3.87
32	Creature	2.37	6.03	4.60
33	Death	3.58	2.97	5.00
34	Development	3.33	2.82	3.07
35	Direction	5.26	3.19	3.83
36	Doctor	5.21	6.62	6.40
37	Dollar	6.98	6.62	6.50
38	Dream	2.05	3.03	4.60
39	Dreamer	1.91	5.10	5.33
40	Dress	2.70	6.93	6.53
41	Dust	5.05	6.67	6.03
42	Engagement	3.70	3.46	4.70
43	Event	1.84	3.72	2.90
44	Factories	3.93	6.87	6.43

No.	Word	R	C	I
45	Fisherman	3.63	6.52	6.50
46	Flag	6.56	6.94	6.60
47	Fork	6.70	6.94	6.57
48	Freedom	2.98	1.98	3.83
49	Friend	4.91	4.89	6.37
50	Furniture	5.95	6.83	6.17
51	Girl	6.09	6.83	6.87
52	Grandmother	3.30	6.66	6.43
53	Gravity	6.02	2.56	3.60
54	Green	1.30	5.46	6.60
55	Grief	4.82	1.86	4.70
56	Happiness	5.74	1.94	5.13
57	Health	2.72	3.54	4.10
58	Hearing	5.65	3.57	3.77
59	Hope	5.33	1.18	3.83
60	Hospital	3.72	6.80	6.53
61	Hotel	3.61	6.80	6.40
62	Hour	5.51	2.93	3.60
63	House	6.81	6.93	6.67
64	Humour	3.07	2.31	4.57
65	Idea	2.72	1.42	2.20
66	Instrument	2.61	6.25	5.67
67	Intellect	2.86	1.83	2.93
68	Interest	3.54	2.20	3.13
69	Islander	3.63	6.28	5.43
70	King	3.72	6.34	6.27
71	Knowledge	2.90	1.56	2.47
72	Leader	3.72	5.83	5.13
73	Letter	6.95	6.94	6.37
74	Lip	2.98	6.93	6.57
75	Lord	3.28	4.18	4.63
76	Love	6.26	1.80	5.60
77	Machine	3.07	6.75	6.00
78	Material	2.28	6.10	5.07
79	Meat	2.05	6.93	6.63
80	Meeting	6.23	4.80	5.20
81	Metal	1.79	6.76	5.87
82	Method	2.23	2.20	2.63
83	Money	3.42	6.63	6.43
84	Month	2.63	3.20	4.37
85	Mule	2.05	6.96	6.60
86	Musician	4.77	6.53	6.13
87	Nail	5.86	6.96	6.50
88	Necessity	1.77	1.97	3.00
89	Opinion	2.21	2.29	3.23
90	Outsider	2.00	5.07	5.27
91	Oven	2.74	6.96	6.40
92	Owner	2.16	5.90	4.23

No.	Word	R	C	I
93	Painter	1.95	6.59	5.87
94	Passion	5.28	1.66	5.30
95	Policeman	2.37	6.69	6.70
96	Power	4.33	2.73	4.47
97	Prayer	3.07	3.60	5.17
98	Present	1.61	3.88	4.80
99	Refrigerator	3.73	7.00	6.67
100	Rock	2.72	6.96	6.37
101	Sadness	5.81	2.47	4.63
102	Safety	3.72	2.25	4.27
103	Salad	4.09	6.83	6.53
104	Sensation	4.07	1.99	3.67
105	Shame	3.33	1.70	4.10
106	Silence	2.05	3.09	4.10
107	Singer	3.91	6.35	6.17
108	Speaker	2.88	6.13	5.67
109	Speech	2.26	4.87	4.33
110	Square	3.86	5.70	6.37
111	Star	6.74	6.73	6.70
112	Storm	3.49	6.45	6.43
113	Strength	2.63	2.90	4.63
114	Symbol	2.70	6.38	6.27
115	Sunset	5.67	6.07	6.83
116	Table	5.91	7.00	6.50
117	Thought	3.23	1.28	2.77
118	Time	6.51	2.47	4.13
119	Truth	3.61	1.69	2.73
120	Umbrella	6.65	7.00	6.60
121	Vacuum	2.77	3.87	4.77
122	Valley	5.88	6.66	6.57
123	Vegetable	3.77	6.76	5.83
124	Vehicle	5.74	6.45	6.23
125	Water	5.70	6.96	6.60
126	Window	6.72	7.00	6.37
127	Wine	3.72	6.96	6.60
128	Winter	4.44	5.83	6.53
129	Workhouse	3.70	6.31	4.00

APPENDIX E-1

Raw Data: High and low values for symbol representativeness and word imagery for the elaboration condition.

Subject	Draw				Synonym				Copy			
	HH	HL	LH	LL	HH	HL	LH	LL	HH	HL	LH	LL
1	1	2	3	2	0	0	2	0	0	0	0	2
2	2	1	3	0	2	3	1	1	0	0	0	1
3	3	3	3	3	1	2	2	1	2	1	1	1
4	2	2	2	2	1	3	1	2	1	0	0	0
5	3	3	3	4	2	0	1	1	1	4	0	0
6	2	3	2	1	3	0	2	1	1	0	3	0
7	2	2	2	3	2	2	0	1	1	0	0	0
8	2	2	2	4	2	2	1	1	1	0	1	1
9	1	1	2	4	2	0	2	1	0	0	1	0
10	2	2	1	1	2	1	2	1	0	0	0	0
11	3	1	2	3	2	2	3	0	1	0	0	0
12	4	2	2	0	2	1	3	1	2	0	2	0
Totals =	27	24	27	27	21	16	20	11	10	5	8	5

APPENDIX E-2

Raw Data: High and low values for symbol representativeness and word imagery for the generation condition.

Subject	Draw				Synonym				Copy			
	HH	HL	LH	LL	HH	HL	LH	LL	HH	HL	LH	LL
1	3	3	2	1	2	0	4	1	0	0	1	0
2	3	4	3	2	0	0	0	1	0	0	0	1
3	2	2	2	0	2	1	2	2	1	0	1	0
4	2	2	4	2	1	1	1	2	0	0	2	0
5	2	1	1	1	2	0	2	1	0	0	0	1
6	4	1	0	3	1	1	0	2	3	1	0	0
7	2	2	2	2	0	3	1	2	2	0	0	0
8	2	1	2	1	2	0	1	1	2	2	1	1
9	3	2	2	1	1	0	2	2	1	0	0	0
10	1	1	3	2	2	2	2	1	1	1	0	0
11	3	3	3	1	1	3	0	0	0	0	0	1
12	4	1	1	1	2	0	1	2	0	0	1	0
Totals =	31	23	25	17	16	11	16	17	10	4	6	4

APPENDIX E-3

Naive and knowledgeable subjects mean representativeness ratings for the symbols in the memorability study

Symbol Name	Naive Subjects Ratings	Knowledgeable Subjects Ratings
Rest	2.18	5.62
Blood	2.08	4.62
Creature	1.55	4.12
Advice	1.63	5.12
City	4.13	3.29
Corpse	2.55	6.54
Bird	4.63	3.83
Odour	4.00	4.58
Dinner	1.68	3.21
Baby	3.65	5.79
Teacher	2.00	6.42
Clock	5.83	5.83
Picture	2.30	3.12
Top	4.38	6.21
Cost	1.65	4.58
Grass	2.20	5.04
Toy	2.00	2.50
Mistake	1.38	6.75
Competition	4.00	4.96
Policeman	1.60	5.00
Power	3.15	6.58
Bar	2.63	2.92
Obedience	1.60	5.67
Flower	4.35	6.37

<u>Symbol</u>	<u>N S's</u>	<u>K S's</u>
Candy	1.55	4.62
Skin	1.40	5.29
Fireplace	4.35	6.46
Back	2.85	4.75
Command	5.40	2.33
Drink	2.18	3.67
Outside	5.73	6.58
Important	2.68	5.92
Home	4.88	3.62
Wide	4.15	4.54
Automobile	6.03	3.83
Kind	2.18	4.58
Above	5.18	3.67
Agreement	3.13	6.83
Ability	1.33	6.87
Equal	6.48	2.92
Excuse	1.33	2.33
Book	4.85	4.50
Front	3.55	5.71
Answer	3.90	4.00
Pipe	4.93	6.37
Cabin	3.98	5.29
Hurt	2.20	3.58
Jail	4.60	5.58

APPENDIX E-4

Presentation Order for the Elaboration and Generation Experiments.

<u>ORDER</u>	<u>STIMULUS</u>	<u>SYNONYM</u>	<u>List</u>	<u>TASK</u>		
1/25.	REST	REPOSE	C	copy	syn	draw
2/26.	BLOOD	PLASMA	A	draw	copy	syn
3/27.	CREATURE	ANIMAL	A	draw	copy	syn
4/28.	ADVICE	COUNSEL	B	syn	draw	copy
5/29.	CITY	METROPOLIS	C	copy	syn	draw
6/30.	CORPSE	BODY	A	draw	copy	syn
7/31.	BIRD	FOWL	B	syn	draw	copy
8/32.	ODOUR	SMELL	C	copy	syn	draw
9/33.	DINNER	SUPPER	A	draw	copy	syn
10/34.	BABY	INFANT	C	copy	syn	draw
11/35.	TEACHER	INSTRUCTOR	B	syn	draw	copy
12/36.	CLOCK	TIMEPIECE	B	syn	draw	copy
13/37.	PICTURE	PHOTOGRAPH	B	syn	draw	copy
14/38.	TOP	SUMMIT	A	draw	copy	syn
15/39.	COST	EXPENSE	B	syn	draw	copy
16/40.	GRASS	LAWN	B	syn	draw	copy
17/41.	TOY	PLAYTHING	C	copy	syn	draw
18/42.	MISTAKE	ERROR	C	copy	syn	draw
19/43.	COMPETITION	CONTEST	B	syn	draw	copy
20/44.	POLICEMAN	PATROLMAN	A	draw	copy	syn
21/45.	POWER	STRENGTH	A	draw	copy	syn
22/46.	BAR	TAVERN	C	copy	syn	draw
23/47.	OBEDIENCE	COMPLIANCE	A	draw	copy	syn
24/48.	FLOWER	BLOSSOM	A	draw	copy	syn
25/1.	CANDY	SWEETS	C	copy	syn	draw
26/2.	SKIN	EPIDERMIS	C	copy	syn	draw
27/3.	FIREPLACE	HEARTH	C	copy	syn	draw
28/4.	BACK	REAR	B	syn	draw	copy
29/5.	COMMAND	ORDER	C	copy	syn	draw
30/6.	DRINK	BEVERAGE	B	syn	draw	copy
31/7.	OUTSIDE	EXTERIOR	C	copy	syn	draw
32/8.	IMPORTANT	VITAL	A	draw	copy	syn
33/9.	HOME	HOUSE	C	copy	syn	draw
34/10.	WIDE	BROAD	C	copy	syn	draw
35/11.	AUTOMOBILE	CAR	B	syn	draw	copy
36/12.	KIND	TYPE	A	draw	copy	syn
37/13.	ABOVE	OVERHEAD	A	draw	copy	syn
38/14.	AGREEMENT	CONSENT	A	draw	copy	syn
39/15.	ABILITY	COMPETENCE	C	copy	syn	draw
40/16.	EQUAL	MATCH	B	syn	draw	copy
41/17.	EXCUSE	PARDON	C	copy	syn	draw
42/18.	BOOK	NOVEL	A	draw	copy	syn
43/19.	FRONT	ANTERIOR	B	syn	draw	copy
44/20.	ANSWER	REPLY	B	syn	draw	copy
45/21.	PIPE	TUBE	A	draw	copy	syn
46/22.	CABIN	COTTAGE	B	syn	draw	copy
47/23.	HURT	INJURE	B	syn	draw	copy
48/24.	JAIL	PRISON	A	draw	copy	syn

CURRICULUM VITAE

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PLACE AND YEAR

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EDUCATION:

Universities: State University College of New
York at Buffalo, B.Sc. 1966
University of Western Michigan,
Kalamazoo, Michigan, M.A. 1968
University of Western Ontario.
Doctor of Philosophy
Expected, 1985

AWARDS:

Department of Health, Education and Welfare
Undergraduate Assistantship, 1965 -1966.
Department of Health, Education and Welfare Graduate
Fellowship, 1967 -1968.
Ontario Ministry of Health Fellowship, 1977 -1978.

EXPERIENCE:

State University College of New York at Buffalo; Speech
Pathologist, Cleft Palate Clinic Summers of 1966 -1967

Board of Education, City of Tonawanda, N.Y.; Speech Pathologist, 1966 -1967

State University College of New York at Buffalo and State University of New York at Buffalo; External Clinical Supervisor for Student Internships, 1966 -1967 University of Iowa; Clinical Research Associate, Stuttering Research Project 1968 -1971

University of Western Ontario

1971 -Lecturer: Program in Communicative Disorders, Faculty of Medicine.

1972 -Assistant Professor: Program in Communicative Disorders, Faculty of Medicine

1975 -Assistant Professor and Clinical Assistant Director: Program in Communicative Disorders

1978 -Tenured.

Currently -Assistant Professor Department of Communicative Disorders, Faculty of Applied Health Sciences.

Editorial Consultant -Canadian Journal of Behavioural Science, Jan./84 -current

Consultant: Southwestern Regional Centre -Palmerston. current.

Convention Committee: Ontario Speech & Hearing Association Convention, London, Ontario. Sept., 1981. Editorial Consultant -Journal of Human Communication, Sept. 1981- 1983

Advisory Committee to the Ontario Ministry of Health:

Allied Health Manpower, 1977

Membership Committee: Ontario Speech and Hearing Association, 1975 -1976

Credentials Committee: Canadian Speech and Hearing Association, 1976 -1977

Executive Council: Ontario Speech and Hearing Association, 1976 -1978

Co-chairman: Convention of the Ontario Speech and Hearing Association, October 19-22, 1977

BOOKS:

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